KNOWLEDGE.

PRINTED BY
SPOTTISWOODE AND CO., NEW-STREET SQUARE
LONDON

KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART.

CONDUCTED BY RICHARD A. PROCTOR.

Div. I

"LET KNOWLEDGE GROW FROM MORE TO MORE."—*Tennyson.*

VOLUME IX.

NOVEMBER 1885 TO OCTOBER 1886.

NEW SERIES.

VOL. I.

LONDON:
LONGMANS, GREEN AND CO.
1886.

INDEX TO VOLUME IX.

NEW SERIES.—VOLUME I.

GENERAL.

General *continued.*

REVIEWS.

MISCELLANEA.

ILLUSTRATIONS.

KNOWLEDGE

AN ILLUSTRATED MAGAZINE OF SCIENCE, LITERATURE, & ART.

VOL. IX.] NOVEMBER 1, 1885. [NO. 1.—NEW SERIES.

THE UNKNOWABLE;

OR,

THE RELIGION OF SCIENCE.

BY RICHARD A. PROCTOR.

> And still the skies are opened as of old
> To the entrancèd gaze, ay, nearer far
> And brighter than of yore; and might is there,
> And Infinite Purity is there, and high
> Eternal Wisdom, and the calm clear face
> Of Duty, and a higher, stronger Love
> And light in one, and a new, reverend Name,
> Greater than any and combining all;
> And over all, veiled with a veil of cloud,
> God set far off, too bright for mortal eyes.—MORRIS.

INTRODUCTION.

THE belief prevails that men of science, and those who accept the teachings of science, do not view religion from the same direction as those did who in old times were ignorant of the greater part of what is now known. It is supposed, further, that the religion of the world, or at least of the civilised world, is threatened, through the progress of science, with a change which would mean something like destruction.

In reality the human race has regarded religion always, so far back as the evidence shows, from the same direction, though what they have seen has altered in aspect as their range of view has increased.

To speak of a conflict between religion and science, is much as though one should speak of a conflict between our view of the universe we have surveyed and our ideas respecting the infinities of space which remain unsurveyed—including those which are unsurveyable through distance. Science means the knowledge which we have, the study of science is the search after such knowledge as we may have. Religion on the other hand depends in the main on the impression produced by what is not known, including always the knowable, but presenting itself more and more clearly to us as in infinitely larger degree unknowable. How can we look at the unknown save from the region of the known? And how can there possibly arise a contest between zeal for knowledge and awe in presence of the unknown?

If science in its steady progress promised or threatened—which should we rather say?—to interpret all things; if the domain of the unknown were ever growing less and less as the domain of the known grows larger and larger, then perhaps men might recognise—not indeed a conflict between religion and science, but—a possibility that such a conflict might arise. The case, however, is not only otherwise, it is the very reverse of this. The domain of the known is, indeed, growing wider and wider, as was foreseen in old times by him who wrote that "Men should run to and fro, and Knowledge be increased": but with the growth of knowledge has come ever clearer and clearer recognition of the truth that the known, let it grow as it may, must always be as nothing compared with the unknown. In old times men thought they knew much; Newton and Laplace said the known is little; the man of science of to-day says the known is nothing. In old times men thought the unknown little; Newton and Laplace said the unknown is immense; today science says the unknown is infinite.

In no sense do we stand, now, in any different position towards religion than was occupied by men a century ago, or a thousand years ago, or when as yet the child-man had but begun to look from what he knew towards the mysterious unknown, from his little spot of surveyed ground to the distant hills as yet unexplored, to the mountains beyond them, to the expanse of ocean seen between the mountain slopes, to the ocean horizon, to the cloud-laden air, and between the clouds to the infinite depths of star-strewn space. We have surveyed a wider region than men of old times. What seemed in past ages unknowable we understand and know. Phenomena that once men explained as supernatural we have learned to interpret as due to natural agencies. What men recognised as due to the direct intervention of deity we see to follow from the operation of law. Where men in old times bared their feet, as judging that they stood on holy ground, we have boldly advanced, as if hoping to approach "the Throne itself where Wisdom reigns supreme." But we have not approached that Throne; for its distance is infinite. We have not entered on holier ground; the ground on which we stood was already holy. We have not interpreted the laws that we have recognised; or only to recognise higher laws beyond our

interpretation. We have learned but to understand phenomena, not that which lies in and through and beyond all phenomena. The prayer of our poet has been fulfilled, or rather it has fulfilled itself. Knowledge has grown "from more to more"—and as a necessary consequence, "more of reverence in us dwells." The man of old times stood entranced before the beauty of the world he saw, stood appalled before the mystery which lay veiled beyond that world: even when imagining the power partly revealed to him as Man-like—in purpose, plan, and passions—the child-man "found religion." How shall the man who sees the grander world disclosed by science, who feels the infinitely greater mystery now veiled beyond the known, who recognises Deity as not measurable or even conceivable by our powers, fail to be moved, nay to be far more deeply moved than men were of old, by religious emotion?

When science in our times passes farther along the same path the same objections are naturally raised. As men in Moses' time might have pleaded for their more easily understood gods and their more obviously enforced duties; as they might have urged that the Jehovah of Moses was by comparison the merest abstraction, with nothing to appeal directly to their senses and their fears such as the gods of Nature had presented; so, many imagine now that there is something much more directly appealing to the emotions, something much more easily understood, in some one or other of the multitudinous beliefs adopted by various bodies, Christian, Mussulman, or Buddhist, than in the Infinities revealed by Science. "I am not moved by the sense of infinite power and mystery," a Mahomedan may say, "but the thought of Allah teaching and leading us through Mahomet is one I can understand and be moved by." So another may find in the idea that Faith in some special dogma is what he must cling to as all-saving, a doctrine more simple, and a guide to conduct more trustworthy, he imagines, than he would have in the recognition of Infinity of Power pure and simple,—in which he finds no other guide to duty than the partly inherited partly acquired conviction (though that conviction permeates the whole being and consciousness of the student of science), that there is a Power outside ourselves making for Righteousness, and that not only the sense of duty but the desire for our own and others' welfare, urges to justice and purity of conduct.

But—an objector will say—"the sense of awe and wonder experienced, be it admitted, by the man of science has no religious value; men cannot worship the unknowable, their conduct cannot be influenced by the consciousness that the universe is infinite, its duration eternal, its energies immeasurable, its variety and vitality inconceivable; such thoughts cannot bring men nearer together in the bonds of kindly fellowship, cannot strengthen men for life's struggle, cannot enable them better to endure life's troubles and sorrows,—in fine men cannot by the contemplation of the infinite mysteries of the universe be made better or braver, worthier or purer."

If we try to answer honestly the question how men have been moved or strengthened or purified by religious emotions in past ages, I do not think we shall be led thus to reject as of small religious value or of none, the impressions produced by the study and the teachings of modern science. It seems to me that men might with fully as much force, that is with no force at all, have raised a similar objection when, for the direct worship of the sun and moon and stars, advanced thinkers strove to substitute the worship of one God, by whom sun, moon, and stars were made. "How can religious emotion be raised," an ancient Chaldæan or Egyptian might have urged, "by what I cannot see? The moon walking in brightness among the fixed stars over which she is queen, the sun glorying as a giant to run his course, the stars (by which he would mean of course the planets, 'as they pursue their wandering course, now high now low then hid, progressive retrograde and standing still') these are manifest powers, though I may not know how they act. These I can worship, these I can propitiate by offering them sacrifice, and in presence of these I must guide my conduct aright, lest they be angry with me and smite me with their unseen arrows. Even if some among us might still be moved by religious emotion, still be strong and brave to endure the sorrows and trials of life, and still be pure in life and conduct, though recognising in the gods of heaven only symbols of a higher power, such as you proclaim, how shall the ignorant and the weak be strengthened and purified, by such an abstraction as you present? Beware how you shake men's faith in that which has so long strengthened them amidst life's trials, and kept them clear of offence, alike towards those glorious beings whom they worship and towards their fellow men."

The same objection was probably raised when other systems of specific nature-worship were attacked. It is well known even that idol-worship was defended against those who sought to purify religion from what seems so obviously unreasonable and contemptible. To this day there are countries where the priesthood of the Roman Church are unwilling to teach that statues and pictures are not in themselves fit objects of worship, lest the influence produced by these material objects on the minds of the more ignorant and dull-minded should be lost, and morality should suffer.

It is because of such considerations as these, because to the great mass of men religious beliefs and practices are necessary which more advanced minds reject, that the religions of to-day, even those which seem purest and best, retain ceremonial observances belonging to times when men worshipped either natural objects, or the powers of nature. Our morning and evening services, our weekly observances, our sacraments, our ceremonies, all come to us from nature-worshipping religions. That doctrine, even, which may be regarded as the very soul of Christianity, the idea of sacrifice, shows itself in the Jewish religion as essentially derived from the practice of sacrificing to the heavenly bodies. Not one of all the sacrificial observances of the Jews, but tells us by its very nature, of its origin *as a ceremonial* in the worship of sun, and moon, and stars. The Feast of the Passover itself corresponded with the Egyptian Feast of the Sun's Passover, his transit across the equator from the gloomy winter depths into which he had descended, to the glory and power of the summer half of his career. So did the enforced gloom of the Fast of Tabernacles (when not to fast was to incur death by stoning) correspond with the mourning among Sabaistic nations as the sun neared the season of his second passover, his transit across the equator from glory to gloom.

What men constantly seem to overlook in urging such objections is that they are not needed where they would apply, and that where they are actually applied they have no existence.

Science certainly teaches a special religion—special in form though general in character. Some have indeed advanced this as an objection against scientific teaching, not because it seemed opposed to religion but because of its con-

structive religions tendencies, not because they thought science threatened to be irreligious but because they were disposed to fear lest it should become religious. But the religious teachings of science can do neither harm nor good to those who do not care for science; and for those who do care for science, who regard the study of the universe as certain to be profitable for doctrine, for training, and for encouragement in good works, the imagined danger has no existence. The question, What are those to do who, being ignorant and unscientific, cannot be moved by the mystery and harmony of the universe? is assuredly a most idle one; seeing that those who are not thus moved to awe and to obedience are also not turned away from that which already moves them to awe and reverence and dutiful service.

It is no mere theory that the change from the comparatively simple and impressive observances of sun-worshippers, to a ceremonial which while similar in outward seeming was carefully freed from all actual worship of the heavenly bodies, would be felt by the more ignorant as a loss. We know that the change *was* felt in that way. We know that for a long time the Jewish people failed to recognise how their religion had been purified when they were taught to regard those ceremonies which still outwardly related to the sun and moon and stars as merely symbolical, when they were enjoined to worship no longer the orbs of heaven but the Power from whom all things proceed. Again and again the people sought to return to nature worship. Again and again they showed their fears lest the powers of nature should be offended if no longer receiving their customary offerings, and no longer addressed as of old in prayer.

What would be thought if one were to say to the master who is training a child for the time when it must put away childish things?—"Forbear! the restraints which affect your conduct, the thoughts by which you guide your own life, have no existence for that child; you cannot trust him to act rightly without the control of others; to teach him that he must hereafter be a rule unto himself, is to deprive him of respect for that which alone can really influence his conduct." Absurd as such an argument would be it would not be more absurd than the objection raised against science, in its relation to conduct and religion, that what it teaches would afford no adequate guide for the conduct, would give no adequate impulse to the emotions, of those who as yet have not mastered the lessons taught by science or have not even heard of them.

But to tell men who *have* learned those lessons that they cannot be moved to religious emotions by the sense of unknowable uninterpretable power, that they find no strength or guidance in the discharge of life's duties in the recognition of the universal presence of law and the unending influence of every act on the happiness of self and of others, is to assert what every student of science knows to be false.

What then is the object, readers may ask, of studying the religion of science, which for those who hold it needs no defence, while those who hold it not are for the present at least in no need of it, or even better without it? My object is *this*,—To show all men that they can enter fearlessly on the study of science, assured that they can never lose thereby what is essential to their happiness and peace; and to show those who do *not* care to enter on scientific studies, that their fellow men who in ever-increasing numbers follow science are not therefore devoid of religious aspirations, of religious hopes, or of religious responsibilities.

THE DISPERSION OF SEEDS.

By Grant Allen.

PLANTS as a class differ in nothing more conspicuously from animals than in their sedentary habits and their comparative want of locomotive power. Few among them are given to gadding about casually. Of course, there *are* locomotive plants, just as there are, *per contra*, fixed and immovable animals, which settle down in life once for all, and never again set out upon their travels—such as the oyster, the acorn barnacle, the sea-anemone, and the coral polypes. Still, viewing the two great divisions of life broadly as a whole, it is quite certain that most of us look upon animals generally as moving bodies, and upon plants generally as absolutely rooted and motionless things. It was not always so, to be sure. In the beginning, there is reason to believe, all living creatures alike, whether animal or vegetable, swam freely about in the primæval ocean; and to this day the vast majority of the lower aquatic plants begin their lives at least, if they do not also finish them, as perfectly locomotive or floating organisms. Terrestrial plants, however, as, for example, the oak and the cedar of Lebanon, are, as a rule, tolerably firmly fixed in the soil beneath them. Once a plant of this class has taken root, it may be said to have chosen its place in life; and thenceforth it seldom goes forth upon the world, but remains quietly vegetating at home, unconscious in any way of the wider ranges of earth beyond it.

This very sedentary nature of the plant kind renders necessary all sorts of curious devices and plans, on the part of parents, to secure the proper start in life for their young seedlings. Or rather, to put it with stricter biological correctness, it gives an extra chance in the struggle for existence to all those accidental variations which happen to tell at all in the direction of better and more perfect dispersion. For, in the first place, if the seeds always fell just below the parent plant, they would necessarily be overshadowed and darkened by its foliage and branches; and since light is almost to the vegetable world what food and water are to animals, this consideration alone would help largely to account for the immense number of curious devices we actually find in nature around us for the due dispersion of seeds far away from the mother organism. Then, again, the young seedlings, if all casually dropped side by side upon the ground together, would choke one another by their mere frequency, a result which really does arise, to a greater or less degree, in the case of almost all the smaller annuals. But, thirdly, we have also to take into consideration the necessity for a rotation of crops, now so perfectly understood by farmers, and understood long before in her practical unconscious fashion by mother nature. Certain plants rapidly exhaust the soil of certain needful mineral constituents, so that after they have grown upon the same spot for a given length of time together, they become dwarf and sickly, and at last fail to extract from the impoverished mould a living on any terms. Hence it is a prior necessity that the seeds of all such plants should be provided with some efficient means of wider dissemination, so that they may be able to migrate from time to time to new situations, on pain of total and immediate extinction for the whole genus. Only those plants finally survive in the ceaseless warfare for life, which are thus enabled by some lucky accident to accommodate themselves to the

stern logic of their own particular and immovable environment.

As a matter of fact, many of the smaller and simpler annuals do merely drop their seeds just beneath the parent plant, and don't suffer much in the long run from the resulting consequences. Some of them are so small, and their roots spread such a very little way in the earth, that the seed can hardly drop out of the capsule without finding a decently-fit position in life. Others grow upon banks or slopes, where the mere lie of the ground enables them to get a fresh foothold—a condition very well exemplified in plants like the wallflower and the ordinary weeds of our cliffs and precipices. In such cases, the chapter of accidents alone suffices to carry away a sufficient number of seeds for the due dispersion and survival of the species. Mr. A. R. Wallace has well noted, however, that in instances of this sort the seeds are usually small and relatively numerous; a great many supernumerary young are produced, out of all which only one or two on an average arrive at maturity. Compare this with the parallel instance of fish among the vertebrates, where sometimes, as with the cod, no less than three million eggs are spawned annually by each female, for the final average production of a single pair of adult codfish.

The first advance from this simplest mode of dropping seeds to take their chance upon the ground beneath is seen in a few plants like our common mouse-ear chickweed, which has the capsule cocked up a little at the end, and opening with small teeth, so as to prevent the seeds from falling out except during a rather high wind. The wind then jerks them out forcibly, and necessarily carries them to some slight distance from the mother-plant. I have very little doubt that almost all the capsules which open at the top only with distinct teeth have been developed for this very purpose, and that they mark an incipient advance from the lower and weedier to the higher and more dominant members of their respective families. For example, in this very same chickweed family, our common chickweed, a plant often self-fertilised, and extremely low in type, has capsules which generally open to the very base, allowing the seeds merely to drop out, hap-hazard, anyhow; while on the other hand the large, handsome, and highly-developed red campion, with its elaborate arrangements for insect-fertilisation, and its division of the sexes on distinct plants, has also a capsule shaped something like an ordinary water-bottle, narrowed at the top, and opening in ten short teeth, so that the seeds can only be shaken out by a high wind, which, of course, carries them away to a considerable distance. The same sort of progressive advance can be traced in many families, from the very simplest to the highest forms.

The yellow-rattle, which grows as a common parasite on the roots of grasses in English meadows affords us an admirable transitional type between these merely casual wind-dispersed seeds and those in which the most advanced devices for wind-dispersion have become fixed and settled by natural selection. Its big inflated capsules are filled with light and flattened seeds, which shake noisily in a gentle breeze, and so have gained for the plant its vernacular name from village children. Sometimes these seeds are distinctly winged, but sometimes they are only flat and thin. In either case, the wind shakes them at last out of the papery capsule, and carries them along a couple of yards or so from their original position before letting them drop upon the soil beneath. Devices like these lead up insensibly to more developed plans, such as that of the maple-tree, where the entire fruit, with the seed inside it, is borne on the breeze by a large expanded membranous wing, so placed that it rotates slowly like a parachute as it falls through the air, and thus almost certainly ensures the wind catching it before it finally alights from its aërial voyage. Every amateur gardener must have observed how very effectual is this means of dispersion possessed by the maple tribe; for young sycamore trees are among the very commonest and most persistent weeds in suburban gardens, even though there may not be an adult sycamore anywhere in sight within a quarter of a mile of the spot where the hardy seedlings are found rooting themselves. Much the same sort of plan is also pursued by the elm, the ash, the pine, and the linden; indeed, the necessity for remote dispersion is, of course, far more obvious in the case of large trees than of any other group of plants, both because such giants of the vegetable world need more space for their roots to grow in, and because the branches of the mother tree more completely overshadow, stunt, and starve the struggling seedlings than in the instance of any smaller and less spreading species.

Still more advanced is the method of dispersion by feathery hairs, such as those of the wild English clematis, the seed of the willow, and the ripe carpels of the pasque-flower anemone. In the red valerian of our cottage-gardens, now self-sown on many west-country cliffs, the calyx slowly unrolls, after flowering, into a feathery crown, which caps the fruit, and enables it to be lightly borne about in every direction by the autumn breezes. The thistles, dandelions, and many other plants of the composite family carry the same provision yet a step further, for here the otherwise functionless calyx has assumed a new use as a kite or parachute, and forms the familiar down which enables the tiny seed-like fruits to float freely through the surrounding air. It is curious to note, however, that some low-growing composites, such as the daisy, assuming a thoroughly weedy habit, and supplied with vast quantities of separate fruits, have found it suit them better to dispense with this special means of aërial dispersion, and seem to trust, like many other degenerate plants, entirely to accident for dissemination.

Animals play so large a part in the fertilisation of flowers that we might naturally expect to find them filling a considerable place also in the dispersion of seeds. And this expectation is fully realised, for an immense number of plants owe their dissemination almost entirely to the good services of birds or mammals, in some cases voluntarily rendered, and in other cases involuntarily. That fruits and berries are so dispersed has long been a familiar fact to naturalists. The bright colour of the pulpy exterior attracts the birds, just as the petals of flowers attract bees and butterflies. The sugary juices and pleasant flavours answer exactly to the honey and perfume. These things cause the fruit as a whole to be eagerly sought and greedily devoured. On the other hand, the actual seed itself is usually enclosed in a hard and indigestible stony covering, or is otherwise protected from the beaks and gizzards of its treacherous friends. In this manner, the sloes, haws, strawberries, and blackberries are reproduced from generation to generation by the kindly offices of our native birds.

The devices for making animals involuntarily act the part of seed-sowers to the enterprising plant, are no less marked and interesting in their own way. Cleavers or goose-grass, the "run-the-hedge" of country children, has its twin fruit covered with an immense number of tiny hooked prickles, which get entangled in the wool of

sheep, or fastened to the legs of passing cows and horses. Being rubbed off by the discontented bearer on the next bush or hedge, often enough in a nice little cake of fruitful manure, the fortunate seeds take root at once under fresh and favourable circumstances, and often prove the precursors of a strong and healthy future stock. In hound's-tongue, the adhesive little burrs cling even more tightly to the passer-by, and are liable to be carried to still greater distances from the parent plant. The burr of the burdock consists of a whole head of flowers and fruits, which separates readily from the dry stalk, and fastens itself firmly to the hair or wool by means of its very hooked and clinging bracts. In tropical countries these bids for cheap carriage are still more frequent and troublesome than in our own poor little northern flora.

Some very advanced plants go so far as actually to disseminate their own seeds, or even to bury them bodily under ground. There is a common little English weed, the wall-cress, abundant everywhere on banks and in dry places, whose pods, especially when touched or shaken, roll up elastically, and scatter the tiny, bullet-like seeds to a distance of some six or seven feet by their powerful impulse. The capsules of the balsam similarly eject the seeds for a considerable length, and everybody must have noticed the crackling of the gorse-pods on bright autumn days, by which means the small beans within are thrown out forcibly with no little violence among the surrounding thickets. The squirting cucumber of Southern Europe, if lightly touched when quite ripe, breaks off at the stalk with a slight bang, and scatters its seeds and their surrounding pulp not infrequently in the face and eyes of the too-intrusive visitor. More remarkable still is the plan adopted by the subterranean clover, in which the undeveloped flowers in the centre of each head act as a sort of insinuating corkscrew, and, screwing slowly downwards, bury the pods of the fertile blossoms at last far beneath the surface of the close-cropped turf. In the familiar pea-nut of American youth the same cunning device is carried to a still further pitch of perfection with Yankee ingenuity; for the so-called nuts are really subterranean pods, produced by self-fertilisation upon simple bud-like underground flowers, and therefore, as it were, ante-natally buried. In these last cases the object is, no doubt, rather to escape the notice of enemies than to ensure dissemination in the ordinary sense, for mere purposes of rotation or dispersal.

Last of all, we have to remember that water aids largely in the dispersion of seeds, especially for marshy or seashore plants. Many fruits of fresh-water kinds have a smooth rind with an oily juice, which the water cannot penetrate, and they are carried down by the current from one spot to another, a point particularly important to shallow water or swampy species, as the course of the stream is constantly altering, and the ponds and backwaters are continually drying up in the hot weather. The sea has transported the cocoa-nut, with its thick shell and hairy covering, almost impervious to salt water, among all the coral reefs and lagoons of the Pacific. Other plants have been carried by the Gulf Stream from the shores of America to the lakes and tarns of the Hebrides, or from the islets of Bermuda to the marshes of the west coast of Ireland. It is probable, indeed, that while wind is on the small scale the great disperser and carrier of seeds, the sea has been in a wider fashion the chief disseminator of the more generally-dispersed groups over the face of the earth. Only those plants whose seed can stand long immersion in salt water are liable to be found in any great numbers over wide tracts of land dissevered by the ocean, or on newly-raised islets in the midst of the sea.

COAL.

By W. Mattieu Williams.

I.—WHERE COAL IS FOUND AND WHEN PRODUCED.

I HAVE been very rude on more than one occasion during my lifetime. I have said, "Sir, your education as an Englishman has been shamefully neglected," to men who read Homer in the original for seaside recreation, who know all the irregular Greek verbs, who can scan, construe, and write Latin verses; even to men who manipulate the differential and integral calculus as glibly as a banker's clerk can sum up money columns, and who have been dragged to the very brink of cerebral meningitis, by dons, tutors, coaches, and examiners. I have perpetrated this rudeness finding that these Englishmen knew little or nothing about the Englishman's peculiar mineral, coal. In some cases my rudeness was applied to men whose incomes were largely derived from royalties on coal that was then in the course of working on their own estates.

An amusing example of this common habit of neglecting common homely things was afforded by a visit of the Earl of Dudley (then Lord Ward) to the Birmingham and Midland Institute in our early days, when we were located in the humble premises of the old Philosophical Society in Cannon-street. I was showing him the collection of local fossils in the museum of the Society. The massive lumps of coral especially interested him. "Very fine, very choice; brought from the tropics, of course," he exclaimed. When I told him that they came, not from tropical seas, but from the rocks upon which Dudley Castle is built, and that the Dudley limestone which yielded so large a revenue to his lordship was chiefly composed of these corals, he eyed me very queerly and suspiciously; but when at last he found that I was quite in earnest, and was backed by a clerical friend who came with him, he was hugely amused at himself, and resolved to give more attention to Dudley corals than he had done hitherto.

Although it may not be the case that *all* the readers of Knowledge are receiving royalties from coal-seams on their private estates, there are certainly none of them who are not receiving large benefits from the coal which is raised and variously worked on the common estate of the British nation. This is even the case with the colonists and foreigners who read this magazine. All, therefore, should follow the sensible example of Lord Ward, and resolve to become better acquainted with so important an element of their national patrimony.

The object of this series of papers is to supply that kind and amount of information concerning our specially English mineral fuel which every intelligent Englishman should possess.

Such information includes a general elementary acquaintance with the geological relations of coal deposits and their probable origin, without struggling with recondite technical details; a general knowledge of how coal-mines are sunk and worked, and of the social condition of the workers; and something about the physics and chemistry of coal itself, and the wonderful multitude of useful and curious products which are now obtained by the distillation of coal and the chemical transformations of the distillates.

At the outset it will be well to sweep aside a widely-spread illusion concerning the geological occurrence of coal. Our ordinary coal, broadly speaking, belongs to one geological period or series of rocks, and this has accordingly

been named the "carboniferous" epoch or group. In like manner we have designated the particular deposits of that great period in which the coal chiefly abounds as "the coal measures." Such names occurring in geological books and on geological charts, and commonly quoted therefrom, naturally suggest the conclusion that these are the only coal-bearing strata. Another source of this popular inference has doubtless been supplied by the speculations of some geologists concerning the state of the world during the carboniferous epoch, speculations involving the idea that once upon a time the whole atmosphere of the earth was abnormally charged with carbonic acid and aqueous vapour; that vegetation just then was exaggerated in its luxuriance; that this period followed a volcanic era which supplied the excess of carbonic acid by eruptions of that gas from its craters, the formation of the gas being due to the roasting of limestone rocks and the combination of the lime with the silicic acid of fused siliceous rocks.

Going back to the article on Coal in the third edition of the "Encyclopædia Britannica," for instance, I find the following:—"The amazing irregularities, gaps, and breaks (says Mr. Magellan) of the strata of coals, and of other fossil substances, evince that this globe has undergone the most violent convulsions, by which its parts have been broken, detached, and overturned in various ways, burying large tracts of their upper surfaces, with all the animal and vegetable productions there existing at the time of those horrible catastrophes, whose epoch far precedes all human records."

This passage is curious and instructive; it expresses in a few words the prevailing geology of the period when Sir Charles Lyell received his first geological teaching, and which he devoted the greater part of his life's work to correcting. He and his successors have shown us that the facts revealed by careful examination of the earth's structure may be explained consistently without the invention of any "horrible catastrophes," or periods of extravagantly violent volcanic convulsions, or deluges, or periods of atmospheric floods of carbonic acid, or any other sensational proceedings of nature far exceeding in volume those now in progress. Allowing a sufficient time for their operation, the forces that are now modifying the crust and surface of the earth are capable of doing all that has been done during the formation of the earth's crust, with no greater or more frequent outbreaks of exceptional violence than those which occasionally disturb the present epoch.

In the eighth edition of the above-quoted national work (that immediately preceding the new edition now in progress), the following geological information is given. "Coal is found in those strata designated the secondary formation, or coal measures, and in seams varying from an inch to forty feet." No mention is made, or indication given, of the existence of coal in any other geological region, thus justifying the commonly-accepted notion that coal is an exceptional deposit, formed during an era when all the world was undergoing an exceptional spasm of exuberant vegetation.

We now know that deposits of some kind of coal exist in every great group of rocks that contain any vestiges of life, and that coal is in course of deposition at the present moment.

The earliest deposit takes the form of graphite, or "black-lead," which contains no lead at all, and is not a "carburet of iron," as stated in many books, but is nearly pure carbon.

This, the softest of solids (I am not speaking of pulpy softness due to semi-fluidity)—so soft that it can scratch no other solid and is scratchable by nearly all, and is filed away by the asperities of the smoothest writing-paper—has the same composition as the hardest of all solids, that which scratches every other solid and is scratchable by none—the diamond. Graphite is found even in the hypozoic rocks, or those lower down or more ancient than any that bear the remains of organic beings. Much has been written concerning the origin of graphite—upon the question whether it is primary and purely mineral carbon, or whether it is an altered vegetable product. I must not be tempted to discuss this at any length, but will simply quote the conclusions of a high authority.

Bischof ("Elements of Chemical and Physical Geology") says, "The geologists who ascribe to the earth an igneous origin, can adopt no other view than that all the carbon upon and in the earth is of secondary origin, and therefore was not present at the period of creation; for the reducing agent of the iron ores would not have remained in contact with peroxide of iron and other oxides in the state of igneous fusion without being converted into carbonic acid and carbonic oxide gases, thus causing the reduction of the oxides. Since the entire group of unstratified crystalline rocks, which, according to the plutonists, have been ejected from beneath, contain in their masses no carbon, this fact must lead them to the conviction that this substance cannot be an original formation."

Bischof is by no means alone in concluding that all isolated carbon found in the earth can "only be regarded as a product of decomposition of carbonic acid, and it is the vegetable kingdom which yielded and still yields this product." The fact that we find such carbon lower down or earlier than any remains of animal life does not disturb this conclusion. Vegetable matter being the primary food of animals, they must have been preceded by vegetables, and probably by immeasurable ages of vegetable evolution, or of zoophyte (animal-plant) evolution, and these lower rocks which entombed the remains of the links of life connecting plant with animal, having been subjected to the metamorphic agencies of crushing pressure and the high temperature that still exists at great depths, could not preserve the forms, though they may have retained the one non-volatile solid element of these primordial living things. Graphite corresponds to this.

Anthracite, as Bischof says, "occupies an intermediate position between coal and graphite," and is undoubtedly of vegetable origin. It is both geologically and chemically intermediate, being frequently found in more ancient rocks than those which bear bituminous coal. This, however, is not universally the case; anthracite also occurs in the same formations as bituminous coal, and is even continuous with it, as will be explained hereafter.

Our richest seams of coal occur in the upper part of the carboniferous group in the "coal measures" above-named. The appended table, copied from Mr. Morris's chart, indicates their position.

The table includes only the Paleozoic rocks where the most ancient or primary traces of life are found. Below them are *Hypozoic* or *Metamorphic* rocks, in which are found no other traces of life than the ambiguous graphite, and below these the granite; above them, a vast world of later growth.

So completely does the coal disappear from the majority of our coal-fields when we go below the upper series of the carboniferous rocks, that the millstone grit has received the name of the "Farewell Rock," experience

having taught the majority of those who bore for coal to bid farewell to their prospects of finding it when this is reached. Nevertheless, in other places good workable coal is found below this, in the mountain limestone and limestone shales, such as the Yoredale rocks and Scaw limestone of the great northern coal-fields of Durham and Northumberland, and still more productively in Scotland.

It would be entering too much into detail to tabulate and specify particularly where coal is found in the later geological ages. I may simply name the oolitic coal field of Whitby in Yorkshire, as one of our British exceptions to the occurrence of coal-seams only in the coal measures. The coal-fields of Richmond, Virginia, is of the same date. Many others of the most important coal-seams of the world, violate the traditions of the British collier by occurring still higher, in the Wealden, the Cretaceous, and higher still in nearly every great series of the Tertiary rocks.

If we fail to find any coal in the Wealden, Cretaceous, and Tertiary deposits south of London, it is not because the existence of coal is there forbidden by any general geological law, but on account of local conditions that prevailed when these rocks were deposited. There are great forests in some parts of the world at the present moment, and a lack of such forests in other parts, even in corresponding latitudes. There are coal-seams now in course of formation in certain limited regions (as I shall describe in my next), but by no means everywhere. This appears to have been ever the case since vegetation began to flourish on the earth.

PALÆOZOIC OR PRIMARY.	PERMIAN OR MAGNESIAN LIMESTONE.	Red sand and marl.
		Magnesian limestone.
		Marl slate.
		Lower red sandstone.
	CARBONIFEROUS.	*Coal measures.*
		Millstone grit.
		Mountain limestone.
		Limestone shales.
	DEVONIAN OR OLD RED SANDSTONE.	Upper Devonian.
		Middle Devonian.
		Lower Devonian and Tilestones.
	UPPER SILURIAN.	Ludlow and Aymestry rocks.
		Wenlock rocks.
		Woolhope series.
	MIDDLE SILURIAN.	Llandovery and May Hill rocks.
	LOWER SILURIAN.	Caradoc and Bala rocks.
		Llandeilo rocks.
		Lingula flags and Tremadoc beds.
	CAMBRIAN	Llongmynd and Cambrian rocks.
	LAURENTIAN	Laurentian rocks.

MR. HERBERT SPENCER ON CHURCH AND STATE.

JUST now, when the question of Church and State in England is somewhat prominently before the public, the philosophical discussion of the general question by Mr. Herbert Spencer, in the just-issued sixth part of the "Principles of Sociology" (Ecclesiastical Institution), has special interest,—though it has not any real bearing on the particular problem about which party politics are disturbed. Mr. Spencer manifestly does not consider the Disendowment of the Established Church a matter of vital moment. He does not even mention it in his chapter on Church and State.

The influence of the Church within a State began when men began to believe in the necessity of propitiating the ancestral dead, learning their wishes, and carrying them out. Whether Mr. Spencer is right in giving to the belief in ancestral ghosts so marked a precedence as he does over the belief in the presence of will and power in various natural objects (in the near at first, and afterwards in those more remote) may possibly be questioned, even in full view of the array of facts he has for evidence. That the worship of dead ancestors long preceded the worship of nature, of the heavenly bodies, of animals, and so forth, is, however, certain—as Schlegel discovered in dealing with Hindoo mythology. And it is equally certain that the first priests, in all nations which have left any records of ancient beliefs, were employed in ministrations for the propitiation of the spirits of dead chiefs: the first altars were mausoleums. Thus we can understand how in those days the kingly and the priestly power would be united in the same person. The secular rule was in the beginning little more than the instrument of the sacred rule,—and, as Mr. Spencer remarks, "where the normal rule has not been broken, the organisations for sacred rule and for practical rule remain practically blended.

When pantheism took the place of ancestor worship, or when almost from the beginning pantheism and ancestor worship were parts of the same primeval system, the priest's duty would still be to propitiate, to interpret, to intercede with, and in some cases even to influence the departed rulers of the people. Thus the power of the priesthood would be immense, their influence wide. We are told that in Egypt, where those great tombs the pyramids, with their astronomical characteristics, tell us of a time when ancestor worship was merging into nature worship, "the priesthood took a prominent part in everything . . . . nothing was beyond their jurisdiction: the king himself was subject to the laws established for his conduct, and even for his mode of living." And it was the same in other ancient nations, while they remained worshippers of their ancestors or of natural objects. "That this blending of Church and State is not limited," says Mr. Spencer, "to societies in which the gods are apotheosised rulers more or less ancient, but is found also in cults which are not indigenous, and that it continues as long as religious beliefs are accepted without criticism, we are shown by the history of mediæval Europe.

Among the causes of the maintenance and growth of Church power in the State, Mr. Spencer cites:—

1. The claim of the priest to give a sanction to the authority of the civil ruler.

2. The influence which the priest is supposed to exert over supernatural beings, by his prayers and invocations,—alike for evil as for good.

3. The assumed power to grant or refuse forgiveness of sins.

4. The attainment of more knowledge than other classes possess,—and in particular the art of writing. Under this head may also be included the circumstance that the civil rulers from the highest downwards, in the earlier times we are considering, receive their teaching from the priesthood.

5. The power resulting from the accumulation of property,—beginning with the accumulation of money paid to them as exorcisers and diviners, "progressing to fees in kind to sacrificing priests, and growing by-and-by into gifts made to temples and bribes to their officials, wealth everywhere tends to flow to the ecclesiastical organisation."

With such powers, natural and supernatural, it might

be thought that in no case could the Church ever become subordinate to the State; that Nonconformity could not even begin to be, far less grow into rivalry with an established Church; and that even if Nonconformity did spring into existence the Church could always maintain superiority, if not supremacy.

In many countries the Church *has* proved irresistible. There have been civilisations which have passed through all the stages of their development to the close of their career, with the Church always indissolubly associated with the State, and always the supreme power. Greece perhaps is the only example among ancient races of a nation where the priestly power did not attain great development.

Mr. Spencer attributes the change—where it is effected—from an original predominance of the spiritual power over the temporal power until ultimately the temporal power bears sway, to that cause which we have found in other cases chiefly operative in determining the higher types of social organisation—the development of industrialism, the modification of Nature caused by substitution of a life carried on under voluntary co-operation for a life carried on under compulsory co-operation—the transition from a social state in which obedience to authority is the supreme virtue, to a social state in which it is a virtue to resist authority when it transgresses prescribed limits. He remarks very justly that the character fostered by the discipline arising from the daily habit of insisting on self-claims while respecting the claims of others, does not favour unqualified submission either to the political head and his laws, or to the ecclesiastical head and his dogmas. Moreover to the moral change must be added the intellectual—"also directly resulting from the development of industrial life—that spreading knowledge of natural causation which conflicts with and gradually weakens belief in supernatural causation."

It is strange for us in England—fortunate here above all other nations except our English-speaking kindred across the Atlantic—to look back on the past condition of our race in this respect. From 1373 until Henry VIII., in 1530, promoted Sir Thomas More, not one of our chancellors, as Blackstone notes in his "Commentaries" was a lawyer,—most of them were ecclesiastics, the rest courtiers. From the year 1592, when Serjeant Puckering was made Lord Keeper, the Chancellor was always a lawyer until 1625, when in the evil Stuart times the Seal was intrusted to Williams, afterwards Bishop of Lincoln.

We may be permitted to regard the loss of that past influence by the Church as a gain, when we note that, as Buckle truly points out, the history of England in the sixteenth and seventeeth centuries shows the power and reputation of the Church "almost always bearing an inverse ratio to the power and reputation of the country at large; rapidly sinking under the brilliant and orderly administration of Elizabeth, and as rapidly rising under the disgraceful and disorderly Governments of the first English Stuarts."

The loss of power by the Church since the extravagant pretensions of the hierarchy in Stuart days have been resigned, has not been inconsistent with a growth of reputation and even of real influence. For though in parts of England where the industrial type of life and organisation predominate, the influence of the Church has naturally diminished, yet among rural populations it has probably increased—with increase of dignity of life and earnestness of purpose among the priesthood of the Established Church.

MOVEMENTS OF THE PLANETS.

By Richard A. Proctor.

THE chart of planetary orbits indicates the movements of the four giant planets during the four next years. The movements of the earth month by month along her small orbit, the third in order of distance from the sun, are also indicated. It will be seen that Neptune is in opposition in November, not only this year (November 16, at 8 a.m.), but next year (November 18, at 7 p.m.), and during several years past and to come. Uranus was in opposition last on March 21, at 8 a.m., and will next be in opposition on March 26, at 10 a.m., and again on March 31, 1887, after which his oppositions for several years will occur in April. Saturn will be in opposition on December 26, at 11 a.m., and will not be in opposition again till January, 1887. (Astrologers, please find some meaning in the circumstance that the whole of 1886 will pass—the first time such a thing has happened in many years—without any opposition of Saturn.) Jupiter was last in opposition on Feb. 19, at 8 a.m., and will again be in opposition on March 21, 1886. If the student will recall that the sun himself is exaggerated in size in the chart, small though he looks there, so that even Jupiter would be far less than the least of the dots set round the orbits, he will probably appreciate the enormous risk to which our solar system has been exposed through the passage of their perihelia by the giant planets. It is easy to draw the orbits and the planets themselves in such a way as to make the risk look terrible; but rightly pictured the solar system is seen to be safe enough from this particular form of danger.

Simple though the illustrative chart is, the planetary movements have never before been presented with the same degree of accuracy in a chart of the kind.

The path of Saturn from conjunction, when he was of course invisible, in 1885 (June 18) to conjunction again in 1886 (July 4) is shown in the smaller figure. No other planet will be in opposition this quarter, except Neptune, whose small loop seemed scarcely worth depicting.

It will be seen that during the first quarter of 1886 Saturn will pass very close to the third magnitude stars μ and η Geminorum.

The small map illustrates one use of my zodiacal maps which is I think worth noticing; the places of the stars have been pricked off from the proper zodiacal chart, and then the path of the planet marked in from the places given in the "Nautical Almanac."*

Next month we propose to give the movements of the four inferior planets, Mercury, Venus, Earth, and Mars, from month to month, during 1886, with suitable explanatory diagrams.

The opposition of Mars in 1886 will also be illustrated next month.

We hope soon to start a series of monthly observations,—that is observations made during a month preceding the time of publication,—by our esteemed contributor "A Fellow of the Royal Astronomical Society."

* I have thought it might be useful to republish these twenty four charts, and have included them in a work now ready for publication, "The Seasons Pictured," in forty-eight sun-views of the earth, twenty-four zodiacal maps, and other drawings.

Path of Saturn, from conjunction in June, 1885, to conjunction in July, 1886.

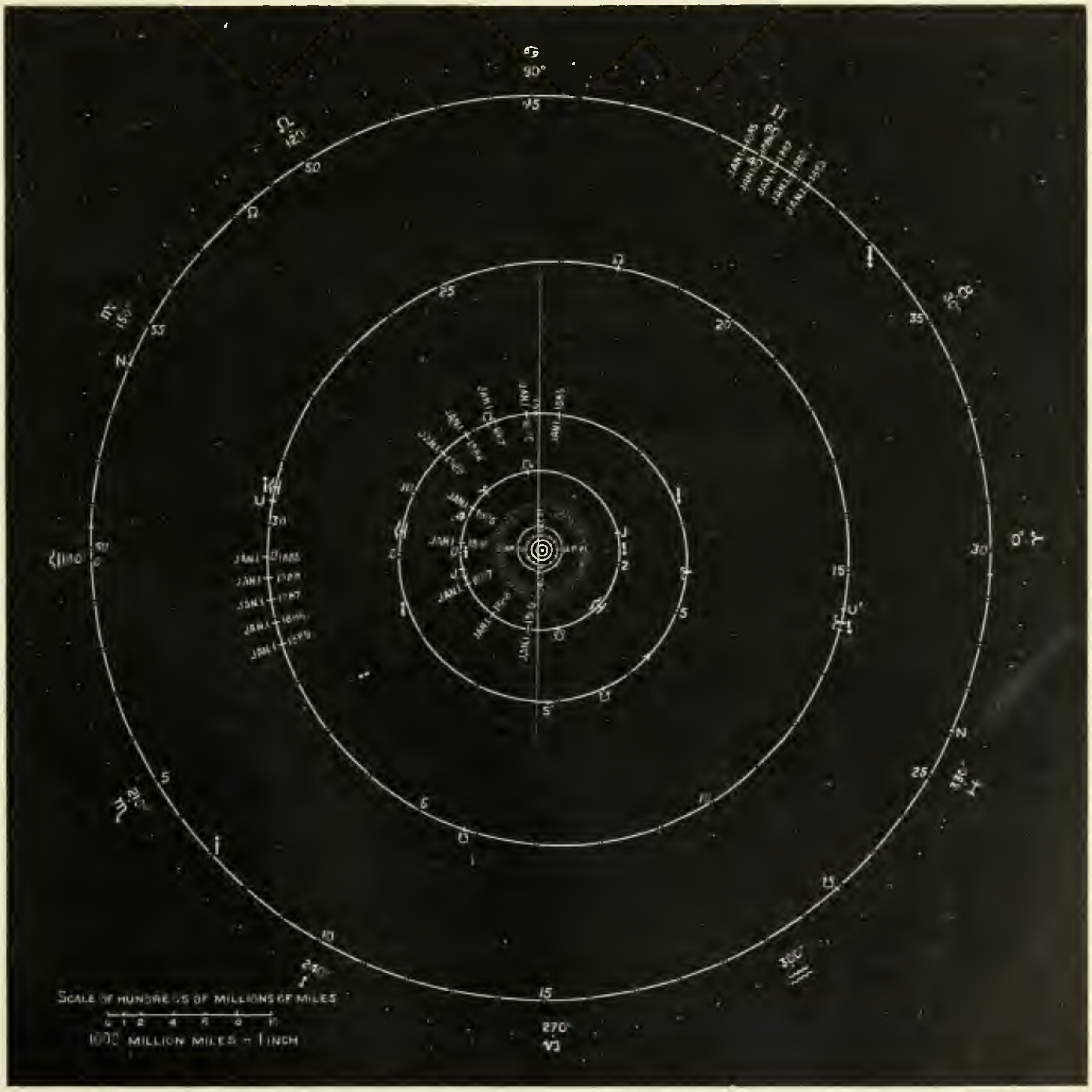
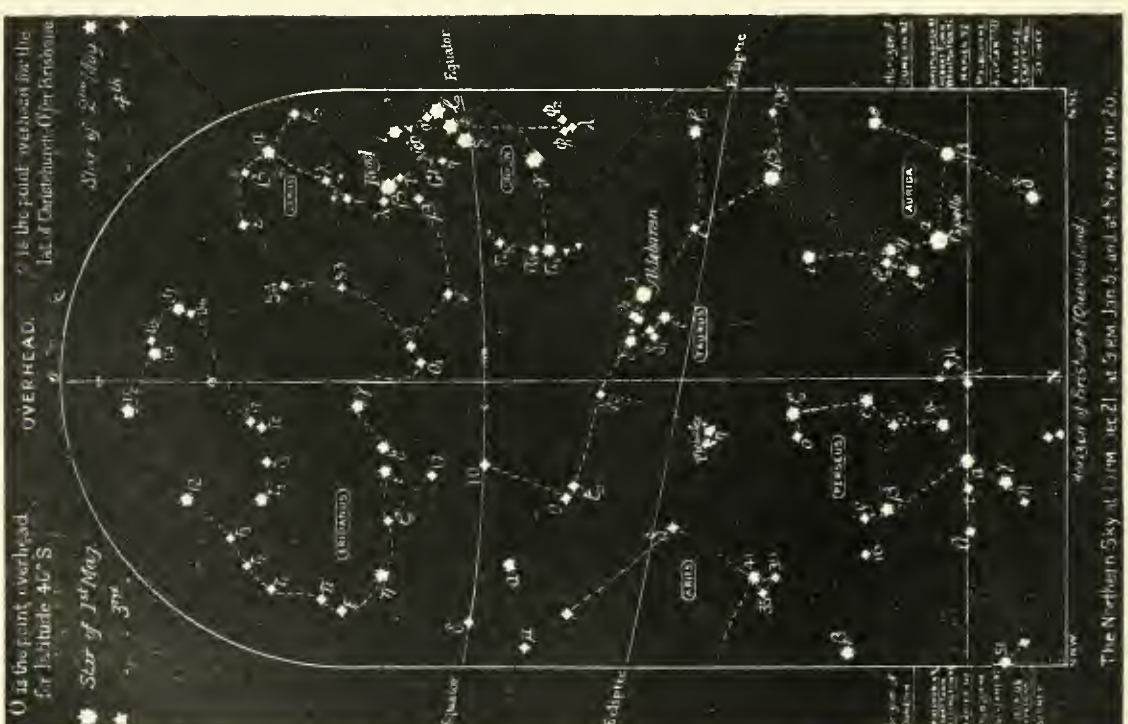


Chart of the Solar System, showing the movements of the four outer planets from January 1, 1885, to January 1, 1889.



The Stars seen towards the north from southern latitudes, and towards the south from northern latitudes, at 10 P.M. December 21, at 9 P.M. January 5, and at 8 P.M. January 20.

THE SKIES OF THE SOUTHERN HEMISPHERE.

By Richard A. Proctor.

I HAVE planned a work for the Southern Hemisphere akin to my "Easy Star Lessons" (drawn up of course for the northern hemisphere). But the small encouragement which Australian booksellers give to the idea, leads me to believe that for the present I shall have to be content with a series similar to my "Star Primer" now just ready for publication, in which the stars are shown fortnight by fortnight in the simplest possible way, at their true relative height above the horizon and also in their true direction with regard to the cardinal points. The series will commence in January with the map for the southern skies in March, so that there may be due time for each map to reach the other hemisphere before the date for which it is intended.

I give this month the northern skies as seen from the latitude of various southern places mentioned on the map. With the kind consent of Messrs. Chatto & Windus, I also give for comparison the corresponding map of the set of forty-eight given in my "Easy Star Lessons." It will be seen that the greater part of the northern map is included in the southern map too, only inverted. By the northern map I mean the one for our northern hemisphere, in which the southern sky is shown: in the southern map the northern sky is given. It is singular to a northerner to see Orion upside down in the northern skies, as the map shows the Giant Hunter, and as he will be shown more fully in next month's map, presenting him due south. A John Hampden in the southern hemisphere would feel that if the stars are seen as in the northern map from our hemisphere and as in the southern map in the southern hemisphere, the starry heavens are in league with the untruthful astronomers: or he might prefer to close his eyes and decline to see the familiar northern constellations as they ought *never* to be seen on the flat-earth theory. But to the student of astronomy the change of aspect as Orion, for example, passes from the south, to the region overhead (when the observer is at the equator) to the north (when the observer has gone south)—precisely as though the earth were a globe! We shall have Hampden denouncing Orion now.

A Message from Mars.—One of those idiots who find it amusing to invent lunar hoaxes, false sea-serpents (thereby silencing those who have seen real, but as yet unclassed, sea-creatures) great gooseberries, and so forth, has amused his leisure moments, which are probably many, in devising an account of certain signalling which appears to be going on in the planet Mars, and to which astronomers on earth are preparing to make reply. The circumstance is interesting as presenting in a new form the perplexing problem Whence had this particular form of idiocy its origin, and how did it attain its present development. The simple idiot we understand, the lunatic we can even appreciate as akin—so we are told—to the genius: but this particular kind of idiocy is not easily to be interpreted.

The Little Naps of Little Fishes.—An experiment has recently been tried at the Inventions Exhibition Aquarium by Mr. W. August Carter, with a view to discover how far fish are prone to sleep. After a close examination, he found that amongst fresh-water fishes the roach, dace, gudgeon, carp, tench, minnow, and cat-fish sleep periodically in common with terrestrial animals. The same instincts were found to actuate marine fish, of which the following were observed to be equally influenced by somnolence, viz., the wrasse, conger eel, dory, dogfish, wrasse bass, and all species of flat fish. Mr. Carter states that, so far as he can discover, the goldfish, pike, and angler fish never sleep, but rest periodically. Desire for sleep amongst fish varies according to meteorological conditions. Fish do not necessarily select night-time for repose.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By Edward Clodd.

INTRODUCTORY.

Happy the man whose lot it is to know
The secrets of the earth. He hastens not
To work his fellows' hurt by unjust deeds,
But with rapt admiration contemplates
Immortal Nature's ageless harmony,
And how and when her order came to be.
Such spirits have no place for thoughts of shame.
Euripides. *Fragment.* 902.

HALF a century ago the public mind of England was agitated by the Tractarian movement, the aim of which, broadly stated, was to undo the work of the Reformation in the Established Church.

Rarely can any age take true measure of its men, or true perspective of its events, and they who watched the signs of those stormy times, deafened by the tumult, deemed that one of the world's great crises, fraught with influences and issues reaching to a far-off future, was impending.

But the Lord was not in that earthquake. Among the leaders of Puseyism there was no maker of an epoch; their movement was retrogressive, a vain endeavour to satisfy the craving of men's better selves with nutriment from musty records of a moribund past.

About the same time Charles Darwin sailed as volunteer naturalist on a five years' voyage in the *Beagle*, a ten-gun brig, commissioned to survey the shores of South America, and to circumnavigate the globe.

Few heeded the departure of that ship, none could foretell what memorable results would follow from her voyage, or know that she carried the man destined to knock the bottom out of all the creeds, and to establish morals and religion on foundations that are independent of the shifting shibboleths of theology; in fine, to revolutionise or profoundly modify every department of human thought, and every motive to human action. But so it was. The true epoch-maker, never dreaming to what large and momentous result his work would lead, passed unheeded, on his return, to his Kentish home, there to consider the significance of the facts gathered during his voyage. The distribution of living things in South America, and markedly in their relation to those in the Galapagos Islands, a group lying five hundred miles off that continent, led Darwin to convictions regarding the mutability of species, and to a solution of the problem of their origin which, after the lapse of nearly a quarter of a century spent in the weighing of every fact and argument telling for or against his theory, was published in the famous "Origin of Species."

"Tract XC." is now remembered only for the part which it plays in Cardinal Newman's fascinating "Apologia," but the "Origin of Species" abides as the imperishable record of the most momentous advance in man's knowledge of the operations of nature since the "Principia."

The pens of many experts, ready writers withal, have enriched our scientific literature with clear and charming expositions of Darwin's theory for the benefit of a public which runs so fast that it has little time to read. But that theory, it must be borne in mind, deals only with organic evolution, *i.e.*, with the origin of the myriad species of plants and animals, and the prominence given to it makes us apt to overlook that it is only part of an all-

embracing cosmic philosophy. For whatever lies within the phenomenal, the seen or felt, and therefore within the sphere of observation, experiment, and comparison, whether galaxy which only the telescope makes known, or monad whose existence only the microscope reveals, is subject-matter of enquiry, both as to its becoming and its relation to the totality of things. It is this more general *conspectus* of the theory of Evolution which it will be the endeavour of the present series of papers to give in clear and, as far as possible, simple words.

Before passing to a detailed exposition of that theory, it is necessary to state as briefly, yet as completely as may be, the problem which, in the judgment of every scientist of repute, it has solved. This involves setting down certain general facts which every school-boy is, theoretically, supposed to know, but which people whose schooldays are long past have, practically, forgotten. That is to say, such matters as the stuff of which all things are made, its combinations and affinities; the relation, likeness, and unlikeness between the stellar and solar systems; between the earth and its fellow planets, large and small; the varied forms and conditions of past and present life, and the relation between these and the inorganic or non-living; the causes of changes now occurring, and which interpret changes that have occurred; these must, one and all, be described as constituting the question to which the answer longed-for, here and there well-nigh grasped, by many kings and prophets of science "who died without the sight," has been given to this generation.

Such statement may not be useless in itself, if it helps to create or to awaken in the mind that feeling of an underlying and indivisible unity between the remote and near, the past and present, the living and non-living, which is apt to lie dormant when things in chemical or vital relation are treated as separate, or as differing in kind. Astronomer or chemist, geologist or palæontologist, psychologist or physiologist, botanist or zoologist, we are all members one of another, and none can say to his fellow, "I have no need of thee." The astronomer captures the truant light from the stars, and the chemist, decomposing it, compels from it the secret of their structure, even the direction in which they travel. The geologist rives the strata asunder, and discloses their succession and contents; the palæontologist, disengaging the fossils imbedded in them, or altogether composing them, finds the ancestral forms of living species and the missing links in the unbroken chain of life. The psychologist may analyse and catalogue the operations of the mind, but the key to understanding them lies in the study of brain-structure and function, of which the physiologist is master; while the botanist and zoologist alike miss the significance of the phenomena of plant and animal life, if these are treated as separate departments of biology. Truly, as Emerson says, "the day of days, the great day of the feast of life, is that in which the inward eye opens to the unity in things."

Yet must we exclaim with the chorus in the "Antigone," and in these days with a deeper meaning, "Who can survey the whole field of knowledge? Who can grasp the clues, and then thread the labyrinth?" For the material is so wide-ranging and varied that in these papers only the barest outline is possible, and in dealing whether with star or species, the one must represent the whole; the individual the class. Our knowledge will, however, thereby advance from the particular to the general, and be enlarged from a mere storage of facts to an all-inclusive philosophy of things; so that although we may not escape errors of detail, we shall be saved by true apprehension of the universal. In illustration of this, we know that all mammals breathe through lungs, have four-chambered hearts, and not less than three bones supporting the tympanum or drum of the ear. Without burdening our memories with the long list of mammalia, we include in the conception "mammal" all that is common to man, ape, whale, &c., never doubting that if a new species of mammal were found it would have the foregoing features.

The matter to be described must not be confused by the intrusion of either the historical or the hypothetical. As far as lies within the writer's power, only the "things commonly believed among us," concerning which the doubting Thomases can have sight or touch, will be set down. But there can be no *detour*, no turning to the right hand or to the left, to tell what theories this or that philosopher of olden or newer time held about the heavens and the earth and the elements; neither what this or that ancient manuscript or tablet records in explanation of their origin; for to refer to such here would be to obscure their value and interest as records of theories which are now discredited, and to invest them with a false importance. Such references to obsolete speculations would be still more confusing when the mechanical explanation to be given of the general and simpler phenomena of the lifeless is extended to the special and complex phenomena of the living, and more particularly to those of the faculties and operations of mind in the lower animals and in man, the highest animal. From tho moneron, a minute structureless mass of slime, to shapely man with the complex apparatus of his mental operations—without pause wherein caprice or chance could enter to disturb the sequence. But caprice and chance are not: the nebulous stuff of which the universe is the product held latent within its diffused vapours, not only the chemical elements of which the dry land and the waters are built, not only the life-germs from which the boundless varieties of plants and animals have descended, or ascended, but aught else that, through work of man for good or ill, has composed the warp and woof of this world's strange, eventful story.

Although much is, however, explained by evolution, and although no limitations can be recognised within the sphere of the phenomenal, there remains much more than is dreamt of in our philosophy unexplained, around the impenetrable marge of which imagination, and the sense of mystery that feeds it, can play. "Positive knowledge does not, and never can, fill the whole region of possible thought. At the uttermost reach of discovery there arises, and must ever arise, the question—What lies beyond?"* The whence of the nebula and its potential life remains a mystery to overawe and baffle us. The beginnings of the crystal are no less unknown and undiscoverable than the beginnings of the cell; the ultimate causes which lock the atoms of the one in angular embrace, and which quicken with pulsating life the globules of the other, lie beyond our ken, beyond the field of scientific inquiry. And if of the beginnings nothing can be known, so is it with the things themselves, and which affect us by their colour, their weight, and movement. They remain the unknown cause of sensations which are themselves, as Helmholtz says, and as Descartes said two centuries before him, only *symbols* of the objects of the external world, corresponding to them only in some such way as written characters or articulate words to the things which they denote. There is no greenness in the grass; there is no redness in the rose; there is no

* *First Principles*, p. 16 (3rd Ed.).

hardness in the diamond; that which our sensations report to consciousness as colour and hardness being the result of myriads of motions, some of which are repeated as often every second as there are seconds in thirty millions of years, motions within us and without us quite unlike one another.

Thought and emotion have their antecedents in molecular changes in the matter of the brain, and are as completely within the range of causation, and as capable of mechanical explanation as material phenomena, but of them no material qualities, as weight, occupancy of space, &c., can be predicated. Heat may be expressed in equivalent foot-pounds, light and sound and nervous transmission in measurable velocities, but these never. We cannot make the passage from chemistry to consciousness, or transform motions of nerve tissue into love, reverence, and hate.

But, to quote the author of the Book of Maccabees: "It is a foolish thing to make a long prologue, and to be short in the story itself," wherefore it is well to pass without further preface to setting forth the framework of the story, that the reader may have clearer understanding of its scope and purpose.

PLAN.

Part I.—Descriptive.

I. The Universe.
Its contents:—Matter, Force, and Energy.
Distribution of Matter in space.
The Solar System and its members.
The Earth as (more or less) a representative member.
The stuff of which it is made.
1. Its inside.
2. Its outside:—
a. Liquid and gaseous envelopes.
b. Solid crust, divided into:—
1. *Unstratified* rocks; features.
2. *Stratified* rocks. Order and succession. Organic remains.
Changes to which these deposits and their contents witness:—
Agencies of change:—
1. Atmospheric.
2. Aqueous.
3. Volcanic.
4. Organic.
5. Man.
Life-forms: stuff of which all are made.
1. Plants: summary of existing species.
2. Animals: " " "
(Intermediate forms.)
Sun as ultimate source of all energy received on the earth's surface.
The unbroken oneness of the Universe.

Part II.—Explanatory.

II. The Universe: Mode of its Birth and Growth.

Statement:—

The Universe, with its non-living and living contents, is the result of the mutual interaction, according to unvarying laws, of the forces and energies possessed by the atoms of which the universe at its birth was composed.

Proof:—

Distribution of matter never the same, it moves in different directions and at different rates, involving
Ceaseless redistribution of matter and energy,

Therefore:—
1. Certain portions of matter come together and form new masses,
or
2. Certain portions of matter are driven asunder, the one process (1) being evolution, the other (2) dissolution. The result is a change of the like unto the unlike, or of the less unlike to the more unlike; of advance from simple to complex.
The like does everything.
The unlike does some things.

Application of this to
1. *Inorganic Evolution.*
Nebular theory of stellar evolution.
Do. of solar and planetary evolution.
Do. as explaining earth-history.
Slow secular cooling.
Azoic (without-life) period.
Evidences of dependence of the living on the not-living. Therefore life takes its place in the chemical history of the earth.
2. *Organic Evolution.*
Darwin's theory of the origin of species by
1. Natural selection.
2 Descent with modification.
Abstract of his theory:—
a. More organisms are produced than can survive.
b. The fittest survive.
c. No two are alike; the tendency is to variation.
Causes of do.
d. Variations are transmitted.
e. Variations must be in harmony with surroundings.
f. Variations result finally in new species.
g. Long time postulated as necessary for changes from primitive organism to man.
Proof of his theory from—
a. Embryology.
b. Morphology (correspondences of type).
c. Geological succession (fossil organisms).
" (intermediate forms).
d. Geographical distribution.
e. Classification.
f. Man's application of it (variation of plants and domestic animals).
Evolution of mind as special form of life.
Dependence of the psychical on the inorganic.
Mind correlated with a complex nervous system, therefore with a material process.
3. *Super-Organic Evolution.*
Application of the theory of evolution to society, morals, theology, language, art, science.
Throughout the foregoing explanation no unknown agencies invoked.

Force indestructible; Energy constant.
Eternal changes rung on Evolution and Dissolution.
Ultimate destiny of the visible universe.

Questions *answered* by Evolution:
Cosmic system explained as natural product of matter, force, and energy.
Origin and development of life and mind, its highest form; therefore explains man as the

most complex and highest result of inorganic and organic evolution.

Questions *unanswered* by Evolution :

What lies beyond the phenomenal.

The beginning of matter.

The origination of motion.

Passage from the action of the brain to facts of consciousness.

Application to that which most concerns man, namely, human relations.

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

COLOUR AND LIGHT.

In describing the refraction of a ray of light by means of a prism (Knowledge, Vol. VI., p. 46) we incidentally referred to the fact (only, however, immediately to dismiss it) that the image of any object seen through such a prism was edged with brilliant colours, and that, in fact, white light passing through it was separated into a sheaf of rays of different refrangibilities, or capacity for being bent from a straight path. For the better comprehension of the subject of colour generally, and of the colours of objects in particular, it now becomes necessary to revert to the use of the prism, and to endeavour to ascertain of what so-called white light is composed, and how it comes to pass, for example, that while a geranium is scarlet its leaves are green.

But before proceeding to our preliminary experiment, let us for a few moments devote ourselves to the consideration of a subject concerning which a good deal has appeared from time to time in our late Correspondence Columns. We have insisted, over and over again, in these papers on the fact that light consists of a series of waves or undulations in some substance which fills the visible universe : and which, for want of a better name, is called the æther. This undulatory motion is purely mechanical ; but the tiny waves, by ultimately beating upon the retina of the eye (Fig. 1) set that in

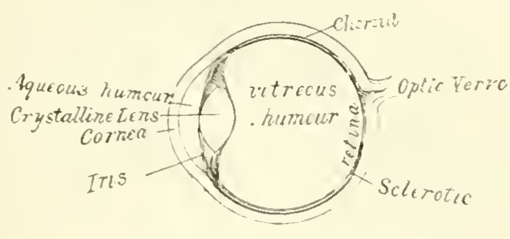


Fig. 1.

turn in vibration, which vibration is communicated by means of the optic nerve to the brain. Then, and not until then, do these purely mechanical undulations become light, as we know it. Furthermore, the multitude of waves of which ordinary white light is composed are of the most various lengths. If we suppose that their length is $\frac{1}{39180}$th of an inch, we shall see what we call red ; shorten them to $\frac{1}{47460}$th of an inch, and we have the sensation of green ; shorten them still farther to $\frac{1}{5490}$th of an inch, and the eye translates them into violet and so on, the colour varying with the length of the wave. But, and this is the point to be especially noted, until they reach the sensorium, they are mere mechanical vibrations. It is the brain, and that alone, which renders them as *colour*. Perhaps this may not be an inappropriate place to add a word, as to a little difficulty which may at this point possibly have struck some very careful reader. We refer to the fact of these rays of such varying lengths all reaching the eye at once. Well, the explanation of this is of a sufficiently simple character. In reality, the undulations are not only of various lengths, but travel with various velocities ; the smaller undulations travelling more quickly than the larger ones, and so all arriving at the eye at once : just as a crowd of men, women, and children might travel in a compact mass if the children took two or three of their little trotting steps to every single stride of the men, and the women timed their pace correspondingly. And now we will proceed to our experiment.

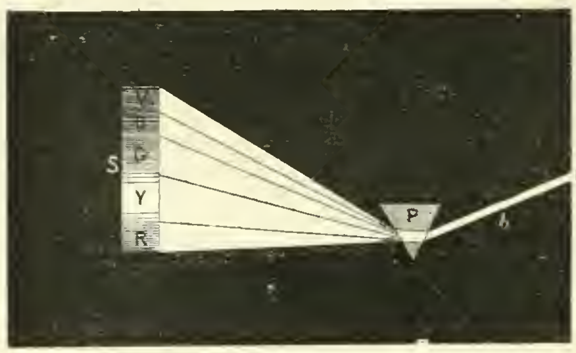


Fig. 2.

Through a hole H (Fig. 2) in the closed shutter of an otherwise thoroughly darkened room, a beam of sunlight H *b* is allowed to enter ; and, of course, as every one knows, will, if uninterrupted, form a round spot of light somewhere on the floor. If now, though we turn one side of the prism (seen endways at) P towards the beam of light, it will pass through the prism, and be projected on a white screen suitably placed, as a long streak of the most gorgeous colours ; those in fact vulgarly known as "the colours of the rainbow." If we suppose our prism to be placed as in the figure with a sharp edge downwards and its flat base at the top, we shall note that, beginning at the top, the light is of a dull violet ; this shades into a strong blue ; as does that into a greenish blue, melting in turn into green. Then we arrive at a region of the spectrum (as our strip of coloured light is called), where greenish-yellow and orange-yellow intermingle in a way which renders the observer doubtful whether pure yellow exists at all. As we descend still farther, the orange-yellow becomes a pronounced and decided orange, and this shades into scarlet, which deepens into a crimson when the spectrum terminates. It will hence be seen, as before intimated, that the violet rays are the most bent from their original path, the crimson ones the least so. We have, as a matter of fact, been repeating Sir Isaac Newton's classical experiment, by the aid of which he demonstrated the compound nature of light. We may avail ourselves of another device of his in this investigation, a device shown in Fig. 3.

It enables us to isolate any particular colour, and to examine it apart from the rest, and consists of a narrow slit *s* in the screen S, letting through light of one refrangibility only. If instead of admitting our beam of sunlight through a round hole in our closed shutter, we

let it in through a very narrow slit, and place the refracting edge of our prism parallel to the length of such slit, we shall obtain a very much purer spectrum, in fact one in which the overlapping of the colours is reduced to a minimum; and any particular tint separated as above described from such a spectrum, is quite indecomposable by refraction through a second prism placed behind the aperture *s* in the screen. As might, of course, have been anticipated, if we receive our spread-out spectrum on a concave mirror, so as to recombine the various colours, the resulting image projected on to the ceiling or a screen, will be a spot of white light. There is this notable

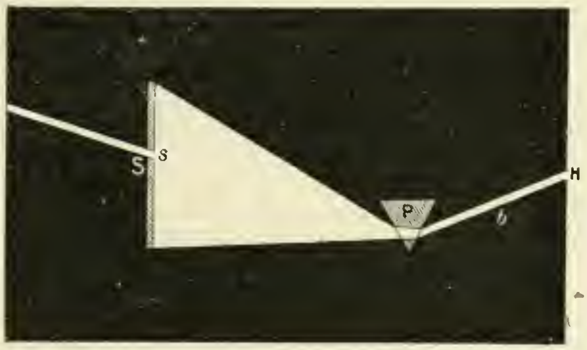


Fig. 3.

difference between the pure colours furnished by the prismatic image, and those emanating from objects lighted by ordinary sunlight: that the latter are always paler than the colours of the spectrum, owing to the admixture of white light with them; the green of a leaf for instance falls short of the green of the spectrum in intensity. It is diluted in this way. And even the strange and almost bizarre colours produced by polarised light fall

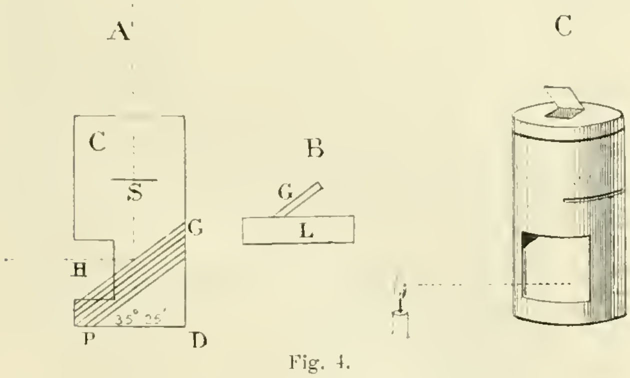


Fig. 4.

slightly short of the purity of those of the prismatic spectrum, as may be seen by splitting off a very thin film of selenite, and inserting it through the slit S in the canister in Fig. 4 (here reproduced from p. 269, Vol. VIII.), so that the beam of light from the bundle of mirrors passes through it *en route* to the smaller one in the lid. A magnifying glass may be used for this observation, if its focus be long enough to enable it to be held at a sufficient distance from the little mirror. Tartaric acid, too, crystallised on a plate of glass and placed in a similar position, exhibits gorgeous colours; yet, as we have just remarked, not quite equal in vividness and purity to those which we obtained by the aid of our prism, an observation equally applicable to the rays of colour in a soap-bubble about to burst.

(To be continued.)

OUR GALAXY.

LETTER TO SIR J. HERSCHEL.

By Richard A. Proctor.

London, July 24, 1869.

I HAVE for several months had it in my thoughts to write to you respecting certain views which seem to me to result from what has been discovered respecting stars and nebulæ, and in particular from the unrivalled series of observations which the scientific world owes to your father and yourself. I have, however, had several reasons for delaying. I have not cared to bring the matter before you until I had gathered a sufficient amount of evidence—and also I have had some diffidence in making a statement which sounds at a first hearing as though intended for a correction of the impressive theories of Sir W. Herschel; though all who have really studied his successive essays on the universe will recognise in my work merely an attempt to advance on the road which he pioneered. If the attempt is a failure you will not the less readily recognise its object.

Although the evidence I have now gathered is far from being so complete as could be wished, yet it is I think sufficient to support many important general conclusions. If it might not seem so to others I think it will to you, who have the means of forming a much readier decision than any man of science now living could do. This is, in fact, one of my reasons for submitting my views to you rather than to any other. There are many eminent mathematicians, many profound physicists, but I know of no one but yourself who is at once mathematician, physicist, and observer, while possessing besides, that knowledge of the whole range of astronomical facts which seems required in deciding on matters such as those I wish to submit to you.

My object is, briefly, to show that there are reasons for modifying our views as to the distribution of stars and nebulæ throughout space. Our own galaxy appears to be rich in a variety of forms of matter or of aggregation not hitherto ascribed to it. It would seem that within a single region of our sidereal system there may be collected,—stars of every variety of magnitude, star-groups of every degree of resolvability, star-streams, gaseous masses, gaseous systems, and in fact all the features which we have been in the habit of looking upon as characteristic (not of any finite portion of our system but) of that quasi-infinite expanse of discernible space whereof our own galaxy has been thought to occupy but a corner.

I will present the points of the evidence as they occur to me, without in general indicating their bearing on my views (to save time and also because you will see in a moment how each part of the evidence bears on the case). Many of the facts are of course already well known to you: but I mention them to make the case complete.

1°. When the irresolvable nebulæ in your large catalogue are isographically distributed (in the manner carried out by you on a smaller number) we find that they show a marked preference for extra-galactic space. Their withdrawal from a given great-circular zone, if not accidental, indicates their association with the sidereal scheme by *some* law. And, as the separate nebulæ have every variety of position, the coincidence of our own galaxy (assumed to be *one* of the nebulæ) with the vacant region—both in place and in position or direction—is too remarkable to be readily accepted as but an accident.

2°. The very easily resolvable nebulæ affect the galactic zone very decidedly, the less easily resolvable nebulæ

affect that zone less markedly, the irregular nebulæ (gaseous) are all on or close to that zone, the planetary (also gaseous) affect its neighbourhood. I need not point out the separate significance of these facts, or their yet greater significance when taken in combination with the fact that irresolvable nebulæ withdraw from the neighbourhood of the galaxy.

3°. Wherever there is a large extra-galactic space singularly clear of lucid stars there also irresolvable nebulæ are singularly few in number.

4°. But where amidst a number of small stars there is a small space singularly clear of stars, there nebulæ are abundant (as both your father and yourself testify).

> [These are not contradictory as they seem at first sight. If we suppose irresolvable nebulæ to be simply aggregations of small stars and star material in place of single (relatively) large stars, we can understand that nebulæ and lucid stars should be wanting *together*, or that in small-star neighbourhoods the formation of nebulæ should *drain* the district. Both facts require to be accounted for as not accidental, and no other explanation seems possible, while this one seems at once natural and satisfactory.]

5°. There are in places well-marked star-streams—such as the River Eridanus which the moderns have carried farther towards the South Pole, and the stream from the water-can of Aquarius, which the moderns have carried over the back of Grus towards the south.

6°. The two last-named streams of stars lead up to the two Magellanic Clouds.

7°. There are well-marked nebular streams in both hemispheres; but two singularly distinct streams in the southern.

8°. The two last-named streams of nebulæ lead up to the Magellanic Clouds.

9°. One of these streams agrees with one of the star-streams named above, the other with the other!

10°. In the Magellanic Clouds are mixed up stars and nebulæ.

> [The Clouds and the evidence they give have been so clearly treated in your "Outlines of Astronomy," that I have no reason for dwelling on the significance of 10°. In conjunction with 5°-9° the evidence seems to me absolutely conclusive as to the association between stars and nebulæ.]

11°. Every one of the irregular nebulæ is strangely associated with stars, which seem (but only seem) to lie much nearer to us. Your maps (in "Southern Observations") and descriptions appear to me conclusive on this point, even where you seem to avoid enforcing the conclusion or to adopt a contrary one. If the coincidence could be accidental in one case, could it in so many?

12°. The Orion nebula has long faint branches extending to ϵ and ι Orionis and condensing around those stars. Can this be accidental? And if not, does it not prove these important points: first that a nebula may be no farther off than lucid stars, and secondly that lucid stars so far apart as ϵ and ι Orionis may belong to a single system?

13°. All those stars mixed up with the Orion nebula whose proper motions have been ascertained, have proper motions singularly small, and coincident in direction—indicating (in a new way) their belonging to one system.

14°. The other stars in Orion have for the most part the same characteristic proper motions (nor need exceptions at all perplex us, considering that we ought to expect them in such cases).

15°. All the stars in Orion (says Secchi) have similar spectra. (Even if this remark is inexact the general significance of what Secchi has observed cannot be misunderstood.)

> [The last points go to prove the real oneness of the Orion stellar and nebular system.]

16°. In particular regions of the heavens particular spectral types prevail—indicating the existence of *star-systems* among the constellations—*i.e.*, among lucid stars. The evidence given by this fact, looked on as subsidiary to the evidence for star-streams, seems important.

17°. In particular regions of the heavens the stars seem to be drifting in a mass towards the same directions.

> [I send a rough copy of a portion of a map of proper motions I am preparing for next meeting of the Royal Astronomical Society.]

18°. The proper motions of stars of smaller magnitudes are not small enough (on the average) for the accepted views as to star-distances. I have taken the proper motions in Main's Catalogue of 1,167 stars common to Bessell's Catalogue and Greenwich Catalogue, and using the formula:—

$$\text{Mean proper motion} = \sqrt{\frac{\text{sum of square of}}{\text{proper motions.}}}$$

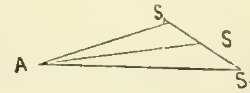
I get:—

$$\left.\begin{array}{l}\text{Mean proper motion of stars of 1st 3 mags.} = 0''{\cdot}301\\ \quad ,, \qquad ,, \qquad ,, \qquad \text{next 3 mags.} = 0''{\cdot}302\end{array}\right\}!!$$

> [I believe this result to be much more than sufficient to prove 18°; but I do not by any means accept it as it stands—or as otherwise than accidental so far as its significance in regard to detail is concerned. Its general significance is as trustworthy as it is obvious.]

19°. The same result follows from the small effect of the correction due to the sun's proper motion, when estimated with reference to the commonly-assumed stellar distances.

> [I venture to point out that it is doubtful whether Mr. Dunkin's result on this point is, as you suggest, that which was to have been *expected*. Does not your reasoning, founded on the number of stars which are moving hither and thither with their *real* proper motions, apply both ways. Every one of those stars is affected by the sun's proper motion. I find by the ordinary rules for determining means that the correction due to the sun's motion ought to be exactly one-half of the sum of the squares of the proper motions, if the sun's motion is equal to the average of stellar motions. There is a simple geometrical proof of this, the chief points of which are as follows:



> —Let S A = displacement due to sun's motion, $S\,S_1 = S\,S_2$ = motion of two stars in opposite directions from S, *foreshortened* and really equal to S A. Then,
>
> Sum of squares of opposite motions $= S_1A^2 + S_2A^2$,
> Sum of squares of ditto *uncorrected* $= S\,S_1^2 + S\,S_2^2$,
> and former sum exceeds latter by $2\,S\,A^2$ (one $S\,A^2$ for each).
>
> And the effect of foreshortening on all motions from S, precisely corresponds to the effect of change of position of S in diminishing S A. Hence for the whole sphere there is an exact equality between

the effect due to the stars' own motions and the effect due to the sun's motions, assuming,—

1. Sun's proper motion = stars' average proper motion.
2. Motions equally distributed in all directions.
3. Stars equally distributed through space.

The evidence (obtained by Mr. Dunkin) that the sun's motion does *not* correct the stars' motions in this proportion—*i.e.*, by one half, establishes the probability that the distances of stars of smaller mags. have been underrated—and that therefore the extent of the effect of the sun's motions upon such stars has also been underrated.

20°. The stars of smaller mags. are not so numerous as they should be according to the theory of uniform distribution.

[Professor Nichol speaks of their number as "according with their theoretic distances," but Struve's hypothesis of the extinction of light was devised to account for a marked want of accordance in this respect.]

21°. The general appearance of the Milky Way is not that which either the theory of a cloven disc, or that of a flattened ring, requires.

[Sir W. Herschel was gradually modifying the disc theory—necessarily the *first* to be adopted after his ganging processes; and you have spoken in many places of the evidence which appears in form of a modified view.]

22°. The well-defined edges of parts of Milky Way prove we are outside its streams; for no cluster of objects within which (cluster) the observer is situated can anywhere appear with well-defined edges.

23°. The great gap in Argo is not explicable on either the disc or the flat-ring theory.

24°. The "Coalsack," though more readily explicable on the latter than on the former, remains a difficulty with either.

25°. The singular want of lucid stars in the "Coalsack" and between the branches in Scorpio, &c., is another difficulty.

26°. The break in the second stream of the Milky Way is a great difficulty.

27°. The knots and clustering aggregations along the Milky Way seem to require a different theory.

[The view I would suggest as roughly explaining observed phenomena is the following* :—This explanation accounts for the singular diminution of brightness from Cygnus to Ophiuchus, and the equally singular increase from Cygnus to Aquila.

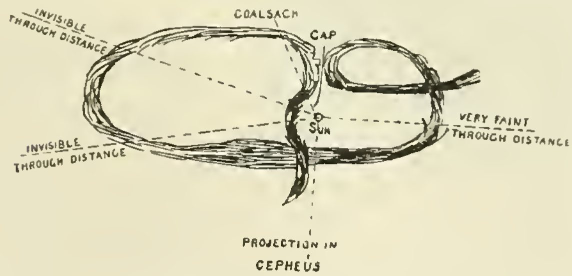


Fig. 1. A perspective view of Milky Way supposed to be depicted on a crystal globe.

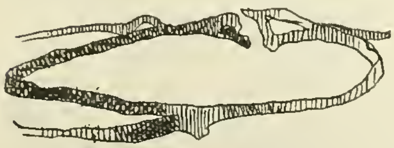


Fig. 2. Suggested general figure of Milky Way spiral in space.

28°. The lucid stars near the Milky Way seem to be intimately associated with it—especially in certain regions.

29°. Along that part of the Milky Way which I have put on the nearest part of the spiral the stars have in many instances singularly large proper motions—also 61 Cygni, and α Centauri, the nearest known stars are on this branch.

30°. The proper motion of the Sun is such as the dynamical conditions suggested by my spiral seem to require.

31°. There are in many parts of the Milky Way outlying streamers. On either the flat disc or the flat ring theory we cannot readily conceive these to be "columnar excrescences bristling up from the general level." Yet were it not for the strong antecedent improbability thus indicated, this would be the natural conclusion, because it is clearly unlikely that *several* sheets of stars would be seen edgewise, even though *one* might be.

32°. In places, a projection of the Milky Way has its apex coincident with a bright star.

Many other points might be dwelt upon as

33°. The fact that certain forms of aggregation are singularly common in certain regions (double stars are less common in Southern heavens, you have noted).

34°.—Variable stars are more common in some places than others—and sometimes variables in certain districts are characterised by the same law and mode of variation, &c.

35°.—The "access to the Nubeculæ* on all sides is through a desert" (Why? unless those regions have been *drained* to form the Nubeculæ).

36°.—The fact that many regular nebulæ are singularly associated with single, double, or multiple stars.

37°.—The existence of those faint "mottlings" (forming streams) which you detected in the southern heavens.

38°.—The fact that in such clusters as Præsepe and Perseus we find nebular tracts (in the former two distinct nebulæ), and that the probability is enormously against this being accidental.

39°. The breaking out of new stars on the borders of the Milky Way.

40°. The indicated existence of dark orbs (causing the irregular proper motions of Sirius and Procyon).

41°. The occurrence of such a change in a star as would lead to the appearance of a so-called "new star"—since it seems far more reasonable to believe that a really minute star has thus suffered a fire change than that a sun resembling ours has suddenly blazed out to many times its usual brilliancy.

42°. The variability and disappearance of many nebulæ.

But for the present the facts before cited seem sufficient for my purpose.

Per contra I know of very few definite facts. There is the general feeling of experienced observers that the nebulæ are far beyond our sidereal system. But on such a point experience avails nothing—or rather no one has yet obtained any experience enabling him to form an opinion, *from observation*, on this point. Experience can tell an observer whether a star apparently single is likely to be doubled with a moderate increase of power; whether an unresolved nebula is or not resolvable and so on: because on these points an observer *can have* experience. But the opinion an observer may form as to the distance

* The figures are copied directly from the sketches in the rough draft of my letter.

* Another name for the Magellanic Clouds.

of a nebula can never be confirmed or disproved, and so he can never acquire real *experience* on this subject.

Many view the careful study and analysis of observations, work which they call "paper astronomy," with contempt. You are not likely to share that feeling, remembering that Copernicus, Kepler, and Newton—to name no more—were paper astronomers. I feel that there is room for a good deal of paper astronomy on the subject of this letter; and that it would be good service to enlist fellow-labourers in *paper-work.* It is not that I undervalue observation—rather that others do. A large mass of observations is available to modern thinkers—but most men prefer to make new observations. In this way the real worth of observation is lost; and further, many who take part in it would do better work in other directions.

My object in writing is very much as follows:—I have been trying to show that useful results could be obtained if a few who have time would overhaul the accumulated mass of observations now lying at the disposal of astronomers. I have myself very little time to work at this subject. If I can save an hour or two a week for such work, it is as much as I can do without injustice to my family. I should like to see many of those now engaged in accumulating preposterously useless observations at work in the field over the fence of which I have looked. A hundred modes of inquiry should be followed up; observed facts should be co-ordinated and rendered significant; new modes of observation should be devised. Thus may clear views, perhaps, be obtained respecting that which it has hitherto seemed hopeless to inquire about—the arrangement and configuration of the star-groups in our own neighbourood, the architecture of the nearer portions of the sidereal heavens.—Yours very truly,

R. A. Proctor.

THE UNIVERSE.

LETTER TO RICHARD A. PROCTOR.

By Sir John Herschel.

Collingwood, Aug. 1, 1869.

I HOPE you will not regard my delay in replying to your letter of the 24th [ult.] as indicating any absence of interest on my part in its subject matter, or in the views you have been led to base on the constitution of our sidereal system. On the contrary, it has been precisely by reason of the number and variety of the striking facts you have brought together, and the evident bearing of a great proportion of them on the great problem it offers to human speculation, that I have been unwilling to make a hasty reply.

I have never participated in that feeling which you designate as "a contempt for astronomy on paper" in the sense of repudiating such speculations as aim at grouping together known but apparently disconnected facts, within one general view, in consonance with known laws,—holding that in the midst of so much darkness we ought to open our eyes as wide as possible to any glimpse of light, and utilise whatever twilight may be accorded us, to make out, though but indistinctly, the forms that surround us.

Under this impression, I should not feel so bigotted to the "ring" or the "disc theory" of the Milky Way, as to reject your proposed system of convolutions, which certainly seems to give a plausible, if not a fully satisfactory account of the gap in Argo, and the break in the following branch of the double stream about Ophiuchus; though I confess that the "Coal-Sack" does not at all give me the idea of the perspective view of a loop, formed by the visual ray passing over one portion, and under another,* of one and the same continuous belt: and the disappearance by the simple effect of remoteness of the interrupted stream in Ophiuchus, would involve, in consequence, a regular progressive diminution in magnitude of the component stars, in approaching the break from either side, down to unresolvable nebulosity and thence to evanescence.†

I do not see the absolute necessity for placing the sun fairly out of the Belt. Distant portions of the Belt from which the sun's position is quite remote may still appear sharply terminated,—and it is a fact that abundance of stars of all magnitudes *are seen* in situations inclined at all angles to the galactic plane, their density increasing gradually and regularly down to that plane.‡

The considerations you adduce relative to the proper motions of the stars are exceedingly curious and interesting.§ Of late years catalogues have gone into so much detail, and with such accuracy, that these motions are, of course, much better known to us than some twenty or thirty years ago. The community of proper motions over large areas, of which you give a picture in Gemini and Cancer is most remarkable, and the coincidence of proper motion in β, γ, δ, ϵ, and ζ Ursæ Majoris is most striking. Your promised paper on this subject cannot fail to be highly interesting.

I cannot say that I am at all surprised at its being found that the average proper motions of stars of small magnitude is not less than of large, considering (as I have always done) that the range of individual magnitude (*i.e.,* lustre) must be so numerous that multitudes of *very* minute stars may in fact be our very near neighbours. But your remark (in your No. 19) on the conclusion I have been led to draw relative to the small effect of the correction due to the sun's proper motion, will require to be very carefully considered, and I shall, of course, give it every attention.

In my Isographic Projection of the Nebulæ, I made no distinction or separation into classes, &c. You appear to have done so (in your second proposition); and the connection of the great mass of globular clusters with the Milky Way in the region about Sagittarius and Scorpio, has led me to conclude, as you seem to have done, a decided connection with, and, in fact, inclusion, in that system, of the clusters in question.

A remark which this connection, and the structure of the Magellaine Clouds, has often suggested to me, has been strongly recalled by what you say of the inclusion

* I am quite with Sir John Herschel on this point, since I have seen the Southern Heavens.—R. A. P.

† By no means necessarily. It is easy to conceive a star-cloud or stream in which the arrangement of the stars of various orders would be such that no order would ever present unresolvable nebulosity at any distance, while the several orders would present the same appearance at all distances, the brighter orders taking the place of the fainter (apparently) as the distance increased.—R. A. P.

‡ On trying Sir John Herschel's gauges in the Southern heavens on a plan proposed by me, and accepted as trustworthy by Sir J. Herschel, Mr. Sydney Walters found the increase of density to be—as I had anticipated—by no means gradual and regular, but rapid, and as it were sudden, in the neighbourhood of the Milky Way, and irregular over the visible cloud-like gatherings in the galaxy.—R. A. P.

§ Sir George Airy, in a letter addressed to me in February, 1873, confounded my discovery of Star Drift with what Pond, his predecessor as Astronomer-Royal, had already noticed. But Pond's observation applied solely to the general drift of all the stars in the heavens, on account of the sun's proper motion through space. This is a very different matter from the drift of star groups, which I had indicated in my maps of stellar proper motions.—R. A. P.

of every variety of nebulous or clustering form within the galaxy:—viz., that if such be the case (*i.e.*, if these forms belong to and form part and parcel of the galactic system), then that system includes *within itself miniatures of itself* on an almost infinitely reduced scale: and what evidence, then, have we that there exists a universe beyond—unless a sort of argument from analogy that the galaxy with all its contents may be *but one* of these miniatures of that* more vast universe; and so on *ad infinitum*: and that there may be in *that* [more vast universe] multitudes of other systems on a scale as vast as *our* galaxy; the analogues of those other nebulous and clustering forms which are not miniatures of our galaxy.†

I hope you will not be deterred from dwelling more consecutively and closely on these speculative views by any idea of their hopelessness which the objectors against paper astronomy may entertain—or by the real slenderness of the material threads out of which any connected theory of the universe (at present) has to be woven. *Hypotheses fingo* in this style of our knowledge is quite as good a motto as Newton's *Non fingo*—provided always they be not hypotheses as to modes of physical *action* for which experience gives no warrant.—I remain, dear sir, yours very truly,

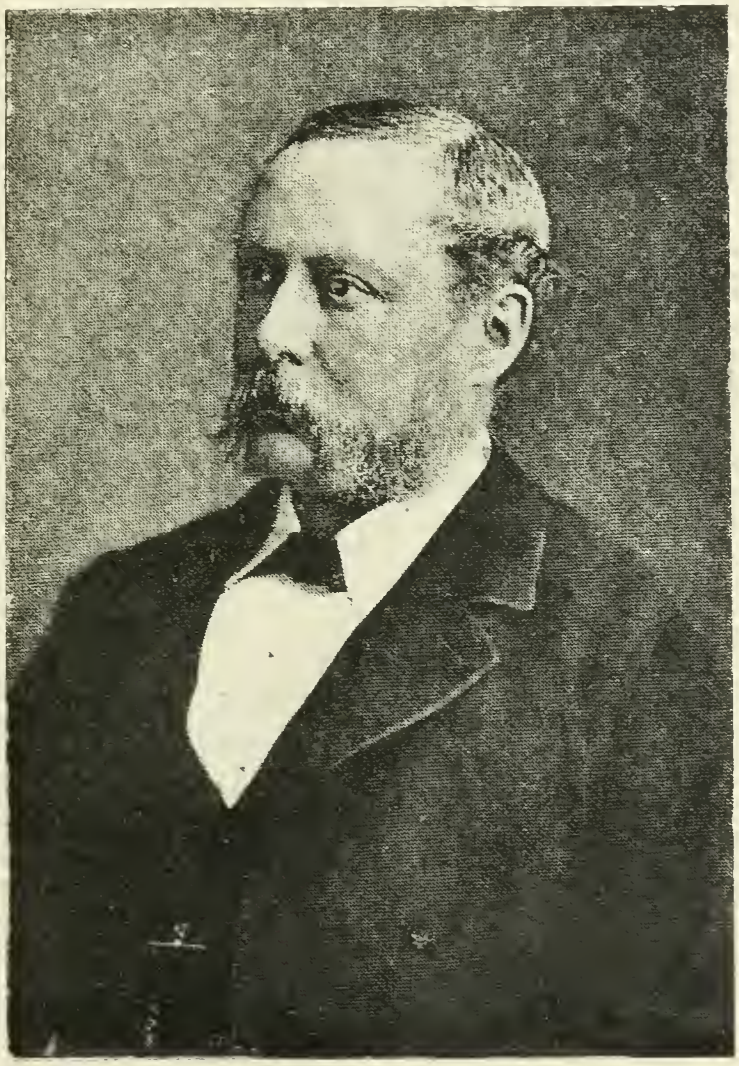
J. H. W. Herschel.

* Possibly a mistake for "a," "that" being anticipated from the, emphatic "that" presently required, and as it were *felt coming*. But the reference may, of course, be to the previously mentioned "universe beyond."—R. A. P.

† Here, as elsewhere in this letter, Sir John Herschel writes in a condensed form, very suitable for the occasion (addressing as he was one who was already fully engaged upon and with the subject) but not quite so fully, or therefore so clearly, as he would have deemed necessary, had he been writing to one viewing the subject from outside. The idea of the universe here presented, one of the grandest that could be imagined, may be illustrated thus:—Imagine insects, examining twigs from some distance, at first under the mistaken idea that they were really boughs, much farther away than they seemed to be. If now any evidence suggested that these objects were not so far away, and being near were *really* smaller than the boughs, a thoughtful insect might say, They seem to belong to the bough, and some of them to be miniatures of it: if so, he might continue, What evidence have we of a bough beyond, unless a sort of argument from analogy that this bough with all its twigs may be but such a miniature of a more vast kind of bough—[a *tree* as our wider knowledge tells us], and that there may be in that [tree] multitudes of other boughs, on a scale as vast as ours, those other boughs corresponding on a larger scale to the other twigs on our bough which are not miniatures of it?—R. A. P.

LUXOTYPE AND THE EDITOR'S PORTRAIT.

THE portrait of the Editor has been obtained by the Luxotype method, about which we wrote at some length in June, 1884. In this method the engraving is purely a nature-process,—landscapes, paintings, and animals (including the human animal divine) can be taken in this way without aid from the engraver, except perhaps to remove here and there such flaws or defects as must occasionally appear even in nature's work. Art comes in, of course, as in ordinary photographic work,—and to this, no doubt, must be attributed the strange mistake of a critic who praised certain luxotype landscapes in a monthly magazine because of the artistic skill with which the engraver had—so said the critic—transformed and spiritualised nature's features! We hope soon to have other opportunities of showing the great value of this new process, and of associated improvements invented by Messrs. Brown, Barnes, & Bell.



RICHARD A. PROCTOR, Editor of Knowledge.

(Printed from a Luxotype process-block.)

We have to thank Messrs. Elliott, Fry, & Co. for permission to reproduce this portrait from their gallery, and for their special kindness in lending the original negative.

The British Race of To-day.—The British race of to-day ought to be tough and enduring, for it has been welded in the past by many beatings. It is a race stubborn to endure, but it is also a race ready to attack. If we are descended from races which have been well beaten, we are descended also from races which have well achieved victory. We share the blood of the Britons, whom the Saxons overcame, but we share also the blood of the Saxons who overcame the Britons. We descend from the Saxons whom the Normans subdued, but we inherit also the blood of their Norman conquerors. It is probably this mixture of many qualities good in contest, fierceness in attack, resolution in defence, daring in enterprise, stubbornness in endurance, which has made the British race what it is. It wants some of the finer qualities we admire in the nations of antiquity, though not altogether unlike the Roman race in some respects. But at present it is beyond all question predominant in the world.

INDIAN MYTHS.

By "Stella Occidens."

> Should you ask me, whence these stories—
> Whence these legends and traditions?
> * * * * * *
> I should answer, I should tell you,
> From the forests and the prairies,
> From the great lakes of the Northland,
> From the land of the Ojibways,
> From the land of the Dacotahs.
> * * * * * *
> I repeat them as I heard them.—Longfellow.

During the long, cold, winter nights, the Indians gather round the camp-fire, and relate the wonderful tales and myths of their country. Under the great pines, in an ever-green forest of the Rocky Mountain region, by the blazing light of the camp-fire, and surrounded by the darkness of night, stands an old man, telling in simple language the story of Ta-wäts, the hare-god, and his encounter with Tä-vi, the sun-god. The Indians are great actors, and tell more by action than by words. The elders listen with reverence, whilst the younger members are often so excited as to dance with delight, or shiver with fear, according to the influence of the orator and his story.

The old man tells them how in long past times the sun god Tä-vi was free to roam about the world at pleasure, scorching people when he came too near, and leaving them shivering with cold when he hid away in his cave. One day Ta-wäts, the hare-god, was sitting round the camp-fire, out in the woods, with his family gathered round him, waiting for the sun-god to come out of his cave and warm them. At last they grew tired of waiting, and fell asleep. The sun-god then approached the hare-god and his family so near that he scorched Ta-wäts' shoulder. Then Tä-vi ran away and hid himself, for he was afraid that the hare-god would be angry. When the latter woke up, and found how badly the sun-god had treated him, he was very angry, and determined to be revenged. He travelled for days and days, meeting with many adventures, and overcoming many obstacles. At last he arrived at the brink of the world, and here he waited patiently until he should see the sun-god. Presently the latter, thinking his enemy had gone, peeped out, and the hare-god shot an arrow in his face, but the rays of the sun burnt the arrow before it reached him. Ta-wäts shot again and again without effect, until at last he sent a magical arrow, which never failed to reach its mark. This struck Tä-vi full in the face, and the sun fell to pieces, setting the whole earth on fire. The hare-god fled, but as he fled the burning earth scorched his feet, his legs, his body, until at last only his head was left. This went rolling along, bumping over rock and crevice, across mountains and valleys, through deep ravines and abysses. Finally the eyes of the hare-god burst, and tears gushed forth in such a flood that it quenched the fire. The sun-god was conquered, and he was summoned to appear before a council to await sentence. The judges condemned him to travel across the sky day after day, on the same path, and he was only to appear at certain times. The days, nights, months and seasons were also regulated by this council.

The Algonquin race have the beautiful myth of the Red Swan, somewhat similar to the above. They believe that the hunter Ojibwa, whilst skinning a bear, noticed that the sky gradually became tinged with a bright red light. He saw a beautiful red swan with brilliant plumage flying across a lake, and tried in vain to shoot it, his arrows proving useless. He then tried three magic arrows, only succeeding, however, in striking the swan with the third. The wounded bird flew off, feebly flapping its wings, until it sank at last under the water. Ojibwa pursued the red swan westward, and discovered that she was the daughter of an old magician. The old man had lost his scalp, which Ojibwa found for him, and put back on his head. The magician then gave his beautiful daughter, the Red Swan, to Ojibwa, as a bride, and they returned to the earth together. In Longfellow's "Hiawatha," this myth is referred to by Iagoo, the marvellous story-teller, at Hiawatha's wedding, when he relates the story of "The Son of the Evening Star":—

> Can it be the sun descending
> O'er the level plain of water?
> Or the Red Swan floating, flying,
> Wounded by the magic arrow?
> Staining all the waves with crimson,
> With the crimson of its life-blood,
> Filling all the air with splendour,
> With the splendour of its plumage?

Shortly after the Sun had been condemned to travel across the sky, another council was held to elect a Moon which was to shine during the night. Whippoorwill, God of the Night, was chosen to preside at this council. After a long debate, a frog offered himself as a willing sacrifice, and was chosen. Various magical incantations and ceremonies were used, and he was changed into the new Moon. Naturally the Moon gives no heat, being made out of the cold body of a frog.

The Dahkotah Indians believe that the Moon is made of something good to eat—as good, probably, as green cheese. When the Moon is full, a great number of small mice commence nibbling until they have eaten it all up. A new Moon then begins to grow until it is full, when it is in turn devoured.*

The Dahkotahs count their months by the Moon, as follows:—

1. Witeri, *January:* the hard Moon.
2. Wicata-wi, *February;* the racoon Moon.
3. Istawicayazan-wi, *March;* the sore-eye Moon.
4. Magaokadi-wi, *April;* the Moon in which the geese lay eggs: also called Wokada-wi; and sometimes Watopapi-wi, the Moon when the streams are again navigable.
5. Wojupi-wi, *May;* the planting Moon.
6. Wajustecasa-wi, *June:* the Moon when strawberries are red.
7. Canpasapa-wi, *July;* the Moon when choke-cherries are ripe.
8. Wasuton-wi, *August:* the harvest Moon.
9. Psinhnaketu-wi, *September;* the Moon when rice is laid up to dry.
10. Wi-wajupi, *October;* the drying rice Moon.
11. Takiyura-wi, *November;* the deer-rutting Moon.
12. Taheeapsun-wi, *December;* the Moon when the deer shed their horns.

The Indians have many myths concerning Day and Night. Schoolcraft, in his "Algic Researches," describes the Huron nature-myth concerning Day and Night:—"Iosco," says Tylor, "seems to be Ioskeha, the White One, whose contest with his brother Tawiscara, the Dark One, is an early and most genuine Huron nature-myth of Day and Night. Iosco and his friend travel for years eastward and eastward to reach the sun, and come at last to the dwelling of Manabozho, near the edge of the world; and then, a little beyond, to the chasm to be passed on the way to the land of the Sun and the Moon. They begin to hear the sound of the beating sky, and it seems near at hand; but they have far to travel before they reach the place. When the sky came down its pressure would

* Neill's "History of Minnesota."

force gusts of wind from the opening, so strong that the travellers could hardly keep their feet, and the sun passed but a short distance above their heads. The sky would come down with violence, but it would rise slowly and gradually. Iosco and one of his friends stood near the edge, and with a great effort leapt through, and gained a foothold on the other side; but the other two were fearful and undecided, and when their companions called to them through the darkness, 'Leap! leap! the sky is on its way down,' they looked up, and saw it descending; but, paralysed by fear, they sprang so feebly that they only reached the other side with their hands, and the sky at the same moment striking violently on the earth with a terrible sound, forced them into the dreadful, dark abyss."*

The Ottawa tribes also believe the Sun and Moon to be brother and sister. "Two Indians, it is said, sprang through a chasm in the sky, and found themselves in a pleasant moonlit land. There they saw the moon approaching as from behind a hill; they knew her at the first sight; she was an aged woman with white face and pleasing air. Speaking kindly to them, she led them to her brother, the Sun, and he carried them with him in his course, and sent them home with promise of happy life."†

There is an Ottawa myth about Manabozho, the solar god, among the Algonquins, which tells about his driving his father, the West, across mountain and lake to the brink of the world, but he was not able to kill him. This conflict is described in "Hiawatha"; the West-Wind or Mudjekee'wis being the father of Hiawatha.

> Then began the deadly conflict,
> Hand to hand among the mountains.
> * * * * *
> Back retreated Mudjekeewis.
> Rushing westward o'er the mountains,
> Stumbling westward down the mountains,
> Three whole days retreated fighting,
> Still pursued by Hiawatha,
> To the portals of the West Wind,
> To the portals of the Sunset,
> To the earth's remotest borders
> Where into the empty spaces
> Sinks the sun, as a flamingo
> Drops into her nest at nightfall
> In the melancholy marshes.
> "Hold!" at length cried Mudjekeewis,
> "Hold, my son, my Hiawatha!
> 'Tis impossible to kill me,
> For you cannot kill the immortal.
> I have put you to this trial
> But to know and prove your courage."

In the Ottawa myth, Manabozho is called Na-na-bou-jou, and is the elder brother of Ning-gah-be-ar-nong Manito, the Spirit of the West, god of the country of the dead, in the region of the setting sun. This sun-hero, Manabozho, when he angled for the King of Fishes, was swallowed, canoe and all; then he smote the monster's heart with his war-club till he would fain have cast him up into the lake again, but the hero set his canoe fast across the fish's throat inside, and finished slaying him; when the dead monster drifted ashore, the gulls pecked an opening for Manabozho to come out."‡ This story is likewise told in "Hiawatha," in the account of the Little Monedo of the Ojibwas.

The Oraibi philosopher who lives in a *pueblo* knows something about architecture; therefore he imagines the world to be a building, and seven stories high. We are supposed to occupy the second story, one being below and five being above. The third story is occupied by the rain-god, who sprinkles the earth with rain by dipping a brush made of birds' feathers into the lakes of the skies. The Indians who live on the cliffs of Arizona believe that the rain is sent for the irrigation of their crops and to refresh the thirsty earth. In the winter this god causes a snow-fall by crushing the ice of the heavenly lakes, and scattering it over the earth.

* Tylor's "Primitive Culture." † *Ibid.*, p. 337. ‡ *Ibid.*

The reason why we occupy the second story of this wonderful building is presented in the following way by the Oraibi philosopher. It was supposed that people originally inhabited a lower world—in fact, the first story. However, they ascended to our world by means of a magical tree, which served as a ladder from the lower world to this. They found the firmament resting low down on the earth, forming the floor of the world, and Mateito, one of their gods, raised the firmament on his shoulders to its present place. He is also supposed to have made the moon out of seven baskets of cotton bolls, woven by seven maidens, and the bits of cotton which were scattered about whilst they worked were made into stars. Mateito then made a sun to keep the people warm, for they complained because the moon was cold. He made the sun of the hair of seven buffalo robes. He also appointed the times and seasons for the heavenly bodies to appear; and the gods of the heavens have obeyed his commands from the day of creation till the present time.

According to the Shoshoni Indians, the sky is ice (being of the colour of ice), and the fall of snow is caused by a monster serpent-god, who coils his huge back against the sky and brushes the ice dust off with his scales. This serpent-god is supposed to be the rainbow,* and the Shoshoni philosophers believe it to be the serpent-god of storm. In the winter-time the serpent sends snow, and in the summer time rain.

Schoolcraft, who spent some time visiting among the Indian tribes, relates a story told by a North American Indian prophetess, describing a vision she had of the Bright Blue Sky. "At her solitary fast at womanhood she fell into an ecstasy, and at the call of the spirits she went up to heaven by the path that leads to the opening in the sky; there she heard a voice, and standing still, saw the figure of a man near the path. His head was surrounded by a brilliant halo, and his breast was covered with squares. 'Look at me,' he said, 'my name is Oshannauegeeghick, the Bright Blue Sky.'" She likewise described the spirit as being ornamented with the hieroglyphic horns of power.†

The North American Indians called the Pleiades the *Dancers*, and the morning star the Day-bringer. Stories are told of an Indian who had long gazed on a star in childhood. One day it left its place in the heavens, and came down to the earth, and talked with him. When he went out hunting, and had poor luck, the star would lead him to a place where there was plenty of game.‡

The Indian myths about the planet Venus are interesting. Longfellow tells in "Hiawatha" how,—

> "The Star of Evening
> Melts and trembles through the purple,
> Hangs suspended in the twilight.
> No: it is a bead of Wampum

* Compare the account of the rainbow by Nokomis, the mother of Weenonah:—

> "'Tis the heaven of flowers you see there
> All the wild flowers of the forest,
> All the lilies of the prairie,
> When on earth they fade and perish,
> Blossom in that heaven above us."

Prettier this than the serpent theory.

† Schoolcraft's "Indian tribes."

‡ Tylor's "Primitive Culture," Vol. I.

On the robes of the Great Spirit,
As he passes through the twilight,
Walks in silence through the heavens!"

Then Iagoo, the story-teller, relates how Osseo, the son of the wandering star of Evening, was beloved by Oweenee, the "silent, dreamy maiden," who refused "all her young and handsome suitors," and married—

"Old Osseo, poor and ugly,
Broken with age and weak with coughing,
Always coughing like a squirrel.
Ah, but beautiful within him
Was the spirit of Osseo,
From the Evening Star descended."

All the heavenly bodies, indeed, were supposed to be human beings or spirits by the North American Indians. The ghost theory was very obviously held among them, not the mere Fetish worship imagined by some modern writers.

ELECTRICITY AT HOME.

By W. Slingo.

ELECTRIC MACHINES.

A PECULIAR charm attaches to electricity, I think, as a source of interest and entertainment, and this apart altogether from the gratification it affords to many thousands as the basis of their daily calling. That this has long been the case is evidenced by what we read of the many devotees to the study of the science during the past two or three centuries. There is, however, some danger, in these days of dynamos and telephones, that what Tyndall has aptly called the "older electricity" will be to some extent lost sight of, or at least regarded with less respect than is merited. This is due, in a measure, to the fact that the study of electricity is bald in the extreme if unaccompanied by experiments, while the cost of performing such experiments efficiently is, as a rule, a heavy item. I should be one of the last to say that the makers of *good* scientific apparatus ask too much for their wares, for the workmanship put into the instruments is worthy of good remuneration; but when one cannot run to the expense of the more costly apparatus, it is false economy to purchase inferior goods. The expense of a first-class article is generally made heavy by the introduction of little details and elaborations, requiring a deal of labour and attention, and yet not essential to the more general application of the instrument, whatever it may be. The working man, moreover, has a tendency to work according to his "stuff," *i.e.*, if he is using common deal where ordinarily mahogany or walnut is employed, he puts in proportionately poorer work and the instrument consequently acts but indifferently. Cheap apparatus is therefore as often as not a delusion. Nevertheless, I think it within the power of anyone of average ability to provide himself with apparatus of a highly efficient character at a comparatively trifling cost. Such apparatus, too, will afford far more pleasure than if it were purchased, while the most inexperienced can, by beginning with simple instruments and producing subsequently more and more intricate ones, gain that experience and knowledge of apparatus which is essential to the real enjoyment of Science and its teachings.

The instrument which, for simplicity of construction, and, at the same time, general utility as a source of experiment, excels all others is the electric machine. With a well-made machine, even if of the smallest dimensions, experiments of an almost endless variety can be performed, while the brilliancy of many of them imparts an interest which for a long time has carried all before it.

Fig. 1 illustrates a somewhat elaborate form of that type of electric machine known as the "cylinder," in which a glass cylinder is caused to revolve between a piece of silk on the one side and a metallically-connected row of pin-points on the other side, the points being connected to a metallic cylinder by means of metal rods, tubes, &c. From such a machine copious discharges of electricity may be readily obtained. Let us, however, consider a simpler form of the instrument, and one which can be well made at a cost not exceeding five shillings. The first thing to do is to get a cylinder. This may consist of a glass bottle or jar such as confectioners use, or it may even be an ordinary plum-jar. It is essential, however, that the surface should be smooth, and free from any irregularities; the sides, too, should be parallel —that is to say, a vertical section should yield two parallel straight lines. Some little care also should be taken in selecting the best or most suitable quality of glass. Some kinds of glass are much inferior to others as insulators. The best sort for our purpose is that

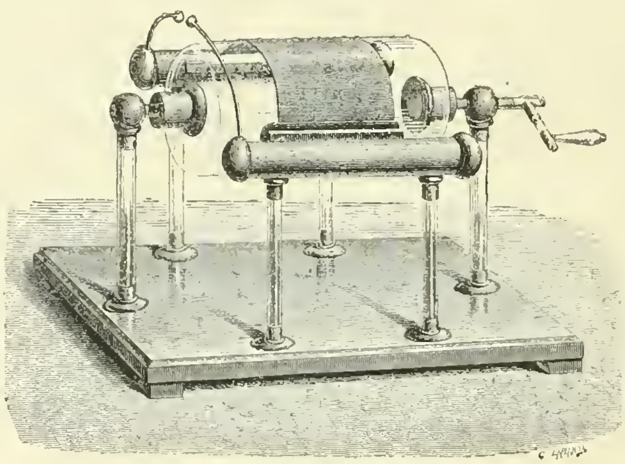


Fig. 1.

greenish-looking glass employed for windows or common bottles. Some trouble is likely to be experienced in procuring a bottle answering to these requirements, and after all it will be found in many cases preferable to purchase a regular cylinder, more especially as the cost is reasonably small, and there is no fear that it will prove too poor an insulator for the purpose. A cylinder four inches in diameter and seven inches long may be purchased for two shillings or half-a-crown. The shape will be found similar to that illustrated in Fig. 2, A B being apertures through which the axis is to pass. Presuming these apertures to be three quarters of an inch in diameter, the axis or spindle may consist of a rod of beech or some other hard wood of about the same diameter. Failing anything better, however, a piece of a stout walking-stick will answer the purpose, or even a broom-handle will do, if one can be procured small enough in diameter. Before the cylinder is fixed on to the spindle the base and supports should be put together so that the cylinder may be properly balanced and a handle fitted. The handle may give a little trouble to make, but it is not a very serious matter. It may be of wood or metal, according to convenience. If it is to be of wood, cut a strip half an inch thick, an inch or so wide, and five inches

long. Near one end cut a half-inch square hole, one end of the spindle being reduced to fit it, a pin being passed through the spindle to prevent the handle working off. The other end of the strip of wood should also be furnished with a half-inch hole to carry the handle proper, which should be well fitted, the portion passing through the strip being at least an inch long, so that a pin or nail may be inserted to prevent the handle falling out. The disadvantage of this arrangement is that the handle itself does not rotate as it revolves, or, in other words, the hand has to slip over it in driving. A much better plan, therefore, is to make a metal handle. This may be done by procuring first a piece of quarter-inch sheet-iron five inches long, an inch wide at one end, tapering down to about five-eighths at the other end. In the wide end drill a hole, and then file out a square hole to fit a corresponding square end produced on the spindle. Next take a piece of quarter-inch iron rod, about five and a half inches long. Produce shoulders by filing a little of the metal away from each end for a distance of five-eighths or three-quarters of an inch at one end (A), and an eighth to three-sixteenths of an inch at

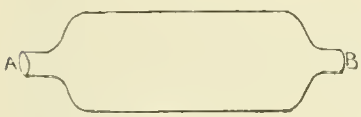


Fig. 2.

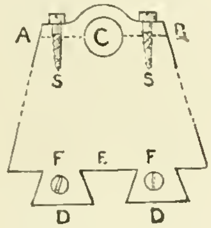


Fig. 3

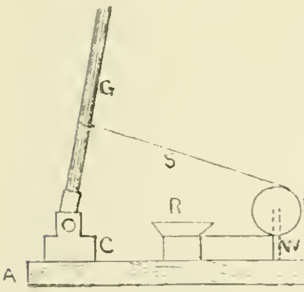


Fig. 4.

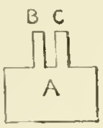


Fig. 5.

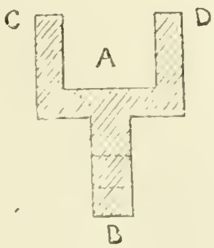


Fig. 6.

the other end (B). Put a metal washer over the end A, the hole in it being only large enough to allow it to pass over the reduced portion of the iron rod. Then drill and file a hole in the narrow end of the strip of sheet-iron, to fit on to the end B of the iron rod. Next place a washer to the protruding portion of B (so that there is a washer on each side of the hole in the strip), then with a hammer well rivet the rod and external washer together, so as to grip the strip tightly. A wooden handle with a hole bored through it from end to end (such as a small skipping-rope handle) is next provided, the hole being a trifle larger than the iron rod over which it is to be passed, and a washer similar to those previously referred to rivetted on to the end of the rod. The wooden handle may then be grasped in the hand when working the machine, as it will pass easily over its iron axis, and so save any risk of injuring the hand, or unduly straining the apparatus.

Let us next turn to the base. The cylinder measures seven inches in length; the projections A B are each about an inch long; half-an-inch clearance must be left between A and B and the respective supports. Allowing, also, three-quarters of an inch for each upright, the total length of the base must be eleven and a-half inches. The breadth should, for reasons presently apparent, be about the same. The thickness of the material should be not less than three-quarters of an inch. The supports should be secured to the base as rigidly as possible. The best plan is to dovetail them. They should be cut from sound stuff three-quarters of an inch thick, and should be three inches wide at the bottom, tapering upwards to two inches or thereabouts—the total length being eight inches or more, and the shape similar to that shown in Fig. 3. With a tenon-saw and keen chisel, the lower portion should be shaped as at D D. Holes should be bored with a centre-bit at C, six inches from E, the diameter being about an eighth of an inch greater than the diameter of the spindle carrying the cylinder. In one of the holes a piece of brass tubing should be inserted, the internal diameter being such as to allow the spindle to revolve easily, but not loosely. The hole in the wood, it is apparent, must be of such a diameter as to cause the tube to fit as nearly as possible to prevent it slipping out. Should there be a tendency to so slip, the tube can be kept in position by indenting each end into the wood, after it has been placed in position. The other upright, after having been bored, should be sawn across, the saw-cut passing through the centre of the hole, as shown by the dotted line, A B. A piece of brass tubing, similar to the one already used, should then be sawn in two, longitudinally, and one of the parts placed in each half of the hole divided by the saw. A single small screw will be sufficient to keep the half-cylinders of brass in position, care being taken, however, to well countersink the screw-hole, and to file off any burr or asperity of any kind that may be left, which, if not removed, would ultimately tend to destroy the spindle. The brasses having been fitted, the upper portion of the support is ready for receiving the spindle and then being screwed down, as at S S, to the main portion. The ends of the base should next be cut, so that the upright supports may fit as closely as possible. If there is the slightest tendency to looseness, means should be taken to overcome or prevent it. The readiest plan is to screw the uprights to the base at F F. The cylinder may now be threaded on the spindle, placed in position, and balanced. It is likely that the spindle will not fit both the apertures tightly. If so, the intervening space may be fitted with thin wedges of wood, or even cork, care being taken that the cylinder revolves truly and is not given to wobbling. Any orifices remaining should be filled up. This may be done with sealing-wax, or with plaster of Paris coated with a film of sealing-wax or varnish. It is better to fill up in this way than to force in unduly a number of wedges, there being in the latter case a considerable risk of fracturing the cylinder. Should it transpire that the adhesion of the cement is insufficient to overcome the tendency of the spindle to run round without the cylinder, notches may be filed across the ends of the projections (A B, Fig. 2) and filled with the cement. This will be quite sufficient for such a machine as the one under consideration. The end faces of the cylinder should be coated with ceiling-wax varnish for insulating purposes, that is to prevent the electricity escaping from the surface of the cylinder to earth by way of the handle. The varnish may be made by dissolving *good* sealing-wax in methylated spirits, or shellac varnish may be made in a similar way, and a red colour imparted by the addition of a small quantity of vermilion. The rubber, or that portion which produces the friction with the glass, is easily made. Procure

(from a draper's. if unable to obtain them more easily) two wooden rollers, five to six inches in length and two inches or thereabouts in diameter. Round off the ends of one of these pieces and plane it down longitudinally, so as to form a flat face, and cover this loosely with a piece of soft leather, filling it out with a quantity of horsehair (or other convenient material) to form a pad. Along one edge of the pad sew a piece of silk four and a half inches long and an inch and a half wide, and along the other edge another piece of silk about the same width but about four inches long. The short piece forms the actual rubber, and the long piece the flap which rests on the upper half of the cylinder. On the under side of the roller (nearest where the silk rubber is attached) bore a hole, half an inch in diameter, and an inch or so deep, and fix in it a piece of half-inch glass rod about four inches long. Next, with the aid of a little flour paste, cover the remainder of the roller evenly with tin-foil. Let the free end of the glass rod be inserted in a half-inch hole bored in another piece of wood. The latter piece is shown in section in Fig. 6. In the upper portion, C D, which may be round or square, the hole A is bored, and the glass rod fitted. The lower portion, B, should be a quarter of an inch thick, an inch wide, and an inch long. Through the centre a hole, a quarter of an inch in diameter, should be bored. This tongue should fit, and work between the similar tongues, B C, in another piece of wood (illustrated in Fig. 5), which also measure a quarter of an inch thick, by an inch long, and an inch wide. Quarter-inch holes being bored through them, a solid pin, an inch long and a quarter of an inch in diameter, should be passed through the three holes, the result being that the glass rod can be worked to and fro at pleasure. The combination is shown sectionally in Fig. 4, where A B is a portion of the base, C the combination of tongues, the lower portion of the bottom piece of wood being screwed to the base from the under side. The plane of motion of the rod G should be at right angles with the spindle, so that the rubber which surmounts the rod may be moved to or from the cylinder. A small pulley (P, Fig. 4), say, an inch in diameter, is fixed by means of a piece of wood or stout wire, W, to a convenient part of the base (under the cylinder), and a half of a cotton-reel, R, is screwed on to the base between the pulley and C. A piece of stout silk-thread. S, is then tied round the glass rod, passed over the pulley, round the reel, and secured in a notch in the rim of the latter. The object of this arrangement is to afford facilities for adjusting the pressure of the rubber against the glass as it revolves. This object can also be attained by increasing the length of the glass rod and attaching the upper part of the collar (C D, Fig. 6) to the base by means of a hinge. The position of the hinge will be apparent. Either of these plans will be found preferable to the ordinary method of screwing the rubber forward from the top of the glass rod.

All that now remains to be provided is that part known as the prime conductor. For this, use the wooden roller above referred to, rounding off the ends so as to remove any sharp edges or points. Then bore in the middle of its length a hole half an inch in diameter and about an inch deep, fitting into a piece of half-inch glass rod about six inches long. The lower end of the rod should be fitted into another piece of wood screwed on to the base. The side of the roller nearest the glass should be furnished with a row of points, obtainable by cutting the heads off a number of pins and pushing them into the wood. The height of the prime conductor should be such that the pin-points are on the same level as the spindle.

The glass rods supporting the rubber and the prime conductor should be coated with a thin layer of shellac varnish, to prevent the electricity escaping.

In my next I shall deal with the question of working the machine, and shall detail a number of interesting experiments that can be worked with it.

THE ORIGIN OF LANGUAGE.

By Ada S. Ballin.

I HAVE said in my essays on "Thought and Language" that the three chief theories of the origin of language are by no means so opposite as is generally supposed, but that it is quite possible that all are equally true. In point of fact, in the preceding series of articles, I have really set out a theory which includes them all, by demonstrating—1, the influence of emotional signs as a part of language (which forms the basis of interjectional theory); 2, the necessity of a system of signs as a means of communication (which, if I correctly interpret Prof. Max Müller's theory by saying that he maintains that man speaks of necessity just as a stone rings when struck with iron, is simply another way of stating that language is a response to a certain stimulus, one means of adapting man to his environment); 3, and lastly, how a purely imitative language, such as that of the deaf and dumb, may be naturally developed.

The great question which so exercised the minds of the ancients, as to why certain sounds (words) were first used to express certain things or ideas, is to a great extent answered by the theory of the natural origin of language, which I am in these articles endeavouring to explain. I believe that just as the origin of thought may be traced back to sensation, so the origin of language may be found in the outward manifestation of the same—in involuntary expressive gestures and sounds, and that these, being found useful, were voluntarily repeated as a means of communication. In co-operation with this purposive element was the imitative tendency, which I have shown to be so highly developed in those at a low stage of intellect. Thus emotional and imitative sounds become part of a system of communication, assisted, as we now find it among savages, by the natural sign-language, and it is also probable that certain sounds, originally uttered at random, in spontaneous exercise of the vocal organs, as among young children, were also affixed by convention to things and ideas with which they had no other relation.

It may be said that man having accidentally found that good resulted from his having given out some emotional sound or gesture, voluntarily repeats the sound or gesture as a means of communicating with his fellows. Having thus voluntarily imitated himself and found it useful to do so, he goes a step further and proceeds to imitate nature for a similar purpose, and as an aid to self-preservation. Thus it is that after all, the imitative faculties are the most important in the production of language, and this truth was evidently appreciated by Plato,* who puts into the mouth of Socrates the opinion that all names, whether primary or secondary, are intended to show the nature of things; and that the secondary derive their meaning from the primary. But how, he queries, do the primary names indicate anything? And then he asks the further trenchant

* "Dialogue Cratylus,"

question: "Suppose we had no voice and tongue and wanted to communicate with one another, should we not, like the deaf and dumb, make signs with the hands, the head, and the rest of the body?" a question which he answers in the affirmative. "We should imitate the nature of the thing; raising our hands towards heaven would mean lightness and upwardness; heaviness and downwardness would be expressed by letting them drop to the ground; the running of a horse or other animal would be expressed by the most nearly similar gestures of our own frame. . . . The body can only express anything by bodily imitation . . . and when we want to indicate our meaning with the voice, tongue, and mouth, is not the indication of anything by means of them identical with their imitation of that thing?" Hermogenes admits the truth of the statement that the name is a vocal imitation of what is named; but then Socrates astonishes him by saying that they have not yet reached the truth, "because then we should be obliged to admit that the people who imitate sheep, or cocks, or other animals name that which they imitate." Here he falls into an error brought about by taking too limited a view of the case. To a certain extent it may be said that those who imitate animals name what they imitate; for if the imitation is good, a second person would at once recognise the animal imitated. But a distinction may here be drawn between those who imitate without having any intention of thereby communicating an idea and those who imitate with the set purpose of naming with the desire of communicating. The former class may be said not to name, while the latter class are certainly naming. Hence the first position held by Socrates was perfectly tenable, the quibble being evidently raised for the purpose of introducing a second proposition which he seems to have considered incompatible with the first, although, as we shall see, the two are by no means opposed to each other, but probably represent co-operating agencies.

Still, through the mouth of Socrates, Plato goes on to propound the theory that the essences of things are expressed in letters and syllables, which must be classified and analysed in order to understand how the ancients, or, perhaps, the barbarians who preceded them, formed language. Thus he thinks motion is generally indicated by the sound R, because in its pronunciation the tongue is most agitated. "Ph," "ps," "s," and "z," are used to imitate such notions as shivering (*psuchron*), seething (*zéon*), to be shaken (*seisthai*), when it is required to imitate what is windy. The closing of the teeth and pressure of the tongue in pronouncing "d" and "t" give an idea of binding and rest in a place, the liquid movement of "l" that of smoothness, as in level (*leios*). "N" sounded from within gives a notion of inwardness, "a" expresses size, "o" roundness, and "ee" (η) length. Here Plato shows a keen appreciation of the physical aspect of the case, as, for example, in pronouncing "a" (sounded "ah") the mouth is at its largest capacity, in "o" the lips are rounded, and in "η" (the sound in pale) they are lengthened out. Laying further stress on the idea that the name signifies the nature of the thing, he continues:—"If the name is to be like the thing, the letters out of which the first names were composed must also be like the things."

Socrates considers that words were made by the legislator, and so constructed as to express the nature of things; but this is to attribute a degree of conscious—voluntary action—of deliberate choice and selection to primitive men which is inconsistent with modern views of their mental development. The greater probability is that the imitation of natural sounds was purely involuntary, and brought about simply by the fact that they suggested themselves, by being ready for use. Thus, animals get names from the sounds they make, and thus emotional cries are repeated to recall the feelings in which they originated. By a further step, also, just as I have shown that the deaf and dumb, and others who communicate by means of manual and physical signs, make movements corresponding in character to the aspects of the things signified, so by analogy harsh and difficult sounds are used in naming unpleasant objects and ideas, while those easy to pronounce are adopted for pleasing things and concepts.

The theory of the origin of language by imitation has, as I have already said, been called the *onomatopœtic* or *name-making* theory (Gr. *onoma*, a name, and *poiéô*, I make), itself a most inexpressive name; its meaning is, however, so well known that it serves as well as any other: for the origin of a word is of little importance provided its present meaning is understood. This is the chief reason why the origin of language is so obscured, for, as I shall show, owing to various circumstances the forms and meanings of words are so changed in the course of years that their original conditions can only be determined with great difficulty. A word having once been adopted, there is no limit to the changes that may be effected in it in accordance with the physical and mental constitutions of the speakers—changes which are accepted by convention: it is, therefore, most unphilosophical to assert, as so many authorities have done, that language could not have had an imitative origin because so few of the words now in use are apparently imitative.

The changes which take place in language are exhaustively classified by Whitney as follows:—*

I. Alterations of the old material of languages. Change of words which are retained as the substance of expression, and this of two kinds or sub-classes:—1. Change in uttered form. 2. Change in content or signification, the two, as we shall see, occurring either independently or in conjunction.

II. Losses of the old material of language, disappearance of what has been in use; and this also of two kinds: 1. Loss of complete words. 2. Loss of grammatical forms and distinctions.

III. Production of new material; addition to the old stock of a language in the way of new words or new forms; external expansion of the resources of expression.

I.—1. Changes in the uttered form of language are largely caused by racial and individual peculiarities in the vocal organs. No two people pronounce any word exactly alike, although the difference is frequently so slight that the ear can hardly detect it; but the difference has a very good reason in the greater or less divergence in the physical constitutions of the speakers. We all know persons who cannot pronounce the letter *w*, others who substitute *w* for *r*, and others again to whom the English sounds of *th*, either as in *that* or in *both*, are insurmountable difficulties. The last two sounds, which are unpronounceable to but few English people, are almost beyond the powers of the French or German nations; while the German *ch*, as in *ach*, is rarely mastered by an Englishman, and the French *r*, as in *grasseyer*, hardly ever. Of the fifty-six elementary sounds known to students of phonetics, many European languages are deficient in fifteen or twenty.

* "Life and Growth of Language." 1879. P. 44.

French has almost entirely lost the sound of *h* as we have it in English, and that that sound is by no means secure in our own land is proved by the 'Arry "'oo 'opes you're very well," and the M.P. who talks of his work "in the '*Ouse*." The Aztecs have no sounds *g*, *d*, *b*, *f*, *h*. Although Hebrew and Arabic are so nearly allied, the sound of *v*, which is common in Hebrew, is unknown in Arabic, while the Arabic initial *w* does not exist in Hebrew. To take another example, there exist in Arabic no less than eight sounds which few, if any, Westerns can ever master, and then only after years of practice.

A sort of natural selection of sounds takes place, an unconscious selection governed by physical peculiarities, which, in their turn, are greatly modified by climate and social conditions. Thus the hardy races of the North have a language largely composed of harsh, rough sounds, in the pronunciation of which much energy is expended. In the luxurious south, however—as, for example, in Italian—the sounds are soft and easy to pronounce. Again, dwellers in thinly-populated districts, who are not driven to talk much, pronounce slowly and carefully, while those who dwell in cities, and who are of necessity great talkers, clip their words, slur over difficult sounds, and even drop them altogether.

These common and everyday sound-changes which are unnoticed in our ordinary intercourse with our fellow countrymen at once become apparent when we converse with Americans, whom we cannot always understand, although their language is our own. So striking are these changes, that in the introduction to his celebrated "Biglow Papers," Mr. James Russell Lowell considered it necessary to make a detailed explanation to his readers, lest they should fail to understand the language he puts into the mouths of his Yankee heroes. He says:—

1. The genuine Yankee never gives the rough sound to *r* when he can help it, and often displays considerable ingenuity in avoiding it even before a vowel.

2. He seldom sounds the final *g*—a piece of self-denial, if we consider his partiality for nasals. The same of the final *d*, as *han'* and *stan'* for *hand* and *stand*.

3. The *h* in such words as *while*, *when*, *where*, he omits altogether.

4. In regard to *a* he shows some inconsistency, sometimes giving a close and obscure sound, as *hev'* for *have*, *ez* for *as*, *thet* for *that*, and again giving it the broad sound it has in *father*, as *hânsome* for *handsome*.

5. To the sound *ow* he prefixes an *e* (hard to exemplify otherwise than orally).

The following passage in Shakespeare he would recite thus:—

> Neow is the winta uv eour discontent
> Med glorious summa by this sun o' Yock,
> An' all the cleouds thet leowered upun eour heouse
> In the deep buzzum o' the oshin buried;
> Neow air eour breows beound 'ith victorious wreaths;
> Eour breused arms hung up fer monimunce;
> Eour starn alarums chănged to merry meetins,
> Eour dreffle marches to delightful measures.
> Grim-visaged war heth smeuthed his wrinkled front,
> An' neow instid o' mountin' barebid steeds
> To fright the souls o' ferfle edverseries,
> He capers nimly in a lady's chămber,
> To the lascivious pleasin' uv a loot.
>
> *Richard III. Act.* 1, *sc.* 1.

The substitution of one sound for another may be either (1) from a defect of hearing, which may be compared to colour-blindness; or (2) from defect of the vocal organs; or (3) from defect of the nervous mechanism supplying them; or (4) from carelessness. The child who, when I said to him "Can't you say *rope?*" indignantly replied, "Well, I did say *wope!*" was probably affected by the first of these alternatives; and the same is most likely true of the Polynesians, who turned *Samuel* into *Hemara*, and *David* into *Raviri*.

Similarly when young children are learning to speak, the same word takes on quite different forms in different months. Thus the word *water* is pronounced by one *ga-ga*, while another utters it *wa-wa*. *Milk* is referred to by one as *wuk*, while another tiny autocrat lustily demands his *mu*, and so on.

In the Malayo-Polynesian group of languages the word *oran*, *man*, becomes in different dialects *rang*, *olan*, *lan*, *ala*, *la*, *na*, *da*, and *ra*. Unconscious changes of this kind are the great cause of the divergence of dialects from a common language, and, by continued differentiation, of languages from a common stock; and Whitney does right in giving it the first place in his classification. Of this differentiation I propose to speak next month, but I would here remark that of the possible number and combinations of sounds, comparatively few are utilised. Prince Lucien Bonaparte has made a list of 385 sounds, seventy-five of which are vowels, which may be articulated; but many of these are not found in any known language or dialect.

The number of possible combinations of sounds which might be used as words has been calculated as follows by Mr. Pagliardini. Allowing that forty-eight elementary sounds may be produced by the human vocal organs, taking these

2 by 2 gives	2,256
3 „ 3 „	103,776
4 „ 4 „	4,669,920
5 „ 5 „	205,476,480

so that a monosyllabic language containing no word with more than five letters could theoretically possess 210,252,488 words; but as some combinations—such as those in which no vowels occur, as, *dtms*, *rsfn*—could not be pronounced, this number may be reduced to one hundredth part, that is to two millions, which would still be a larger number than the sum total of all the words in all the languages of Europe.

The laws of phonetic change are partly those of the physical relation of articulate sounds, but partly influenced by human will—aversion to certain efforts, choice of particular forms, sense of euphony and proportion, and all the thousand motives which influence human action.

Every law of speech has its origin in the physical and mental constitution of the users of speech, in their capacities, necessities, likes and dislikes, in their circumstances, natural and historical, and in their inherited and acquired habits.

Owing to the manner in which languages grow and decay, there has been a great tendency to regard language as a living organism, but this is mere mythology. Languages are the slowly-elaborated products of the application by human beings of means to ends, the result of the devising of signs by which ideas may be communicated, and the operations of thought carried on. Language may, therefore, rather be compared to a building, each individual brick of which has to be made and proved worthy before it can be added to the noble pile. Every item of speech had its beginning either in accident or design, and whether it maintained itself and obtained currency depended on whether it supplied a want.

THE BOOK OF GENESIS,

WITH SPECIAL REFERENCE TO THE IDEAS OF MEN IN OLD TIMES ABOUT THE SUN, MOON, AND STARS.*

By Richard A. Proctor.

OF Dr. Payne Smith's Commentary on the Book of Genesis, regarded as a contribution either to religious literature or to Exegesis (to use a somewhat affected technicality) I propose to say little here. It presents, as does his introduction to the Pentateuch, that singular mixture of profound learning in regard to details of ancient history and literature, with childlike and bland acceptance of the literal meaning of passages which would be absurd if not allegorical, which characterises so many of these works. One cannot help liking the *naïve* simplicity of the teaching, or feeling that for babes and sucklings it must really be very nice and may even be very nourishing (however unfit for grown folk). When we read that "the demeanour of Adam is extraordinary," that "Eve was more quiet and observant," that "Adam had little sense of responsibility" (rather hard on us by the way), but "the woman's answer was far nobler," while "the serpent stood there without excuse" and therefore "was condemned to crawl" though probably it had not "even originally, been erect and beautiful," nor probably had "Adam tamed serpents and had them in his household," as some fondly imagine—one wonders for what sort of children (five, ten, or twelve years old, or what?) the kindly doctor's commentary is really written. Then again, though this is going back a page or two, "they heard the voice of the Lord God walking in the garden"; "really," says Dr. Smith, "this is in admirable keeping with the whole narrative; and Jehovah appears here as the owner of the Paradise, and *as taking in it His daily exercise;* for"—the quality of this reason is exquisite; *for* the verb is in the reflective conjugation, and means 'walking for pleasure.'" (The Infinite taking a constitutional!) This, though it corresponds well with the rather puerile quality of the scientific excursions of the reverend author, sounds oddly in company with the really sound and instructive remarks on linguistic, historical, and exegetical matters. One is reminded of the curious combination of learning and simplicity in the old Greek and Latin school-books,—where profound knowledge of linguistic details is found in company with utterly childlike innocence of the ways and wants of young learners.

Only on one point need we be at all severe with a book of this bland character. Dr. Smith makes the remark, utterly erroneous, though no doubt he imagines it true, that "the unwise disputes between science and theology almost always arise from scientific men crying aloud that some new theory just hatched is a disproof of the supernatural, and"—this is right enough no doubt—"from theologians debating each new theory on the ground of Scriptural exposition." I venture to say that *not a single dispute* between science and theology *has ever arisen* from scientific men proclaiming anything in regard to the bearing of new theories, or even of established truths, on belief in the supernatural. The theologians may safely be defied to cite a solitary example of that which Dr. Smith describes as occurring *almost always* in such cases. *Invariably*, I believe, (*almost always*, I am certain,) the man of science with a new discovery, or a new theory, or a new truth, has had no thought or care about its bearing on the supernatural; he has never cried aloud, or thought of crying aloud, about anything of the sort; *but*, when he has indicated his discovery, or theory, or new truth, some watchful theologian has been ever ready to proclaim, "Oh, we can *not* admit this, it is inconsistent with what we have been teaching"—and later when a truth has been established "Oh, that is no new truth, it has been implicitly involved in our teaching from the beginning,"—forgetting later still that they had started the dispute.

It would seem as though, having had so often to follow this not very dignified course, the weaker theologians had rather lost temper, and like the losing player in a well-known story had been moved to kick the first they came across. The kicked in that story was attending, like the student of science, to his own business—tying his shoes, in fact; but, when he urged this, the angry loser said, not quite truthfully, "You're *always* tying your shoes in my way."

I propose, however, to consider the book before me from the scientific standpoint,—and therefore say no more about its qualities as a religious treatise, except to remark that the tone of the general introduction, from the pen of my much-esteemed teacher in divinity in old King's College days, Dean Plumptre of Wells, is in my judgment admirable. His remarks on the mechanical theory of inspiration are excellent; and his opinion is undoubtedly just that were such a theory accepted we must accept along with it the necessity of an infallible interpreter of an infallible book,—a circumstance which gives to the Roman Church its essentially logical standing-ground. On the other hand, what has been called the dynamical theory of inspiration is open to no such objection. This theory undoubtedly adds immensely to the value of these ancient records regarded with reference to the light they throw on the history, science, literature and religious ideas of ancient times.

As a matter of fact the older books of the Bible, and even some of the later, ought to be of great interest to all men, outside of the religious value we may assign, or decline to assign, according to our lights, to these works. To one who accepts the doctrine of absolute verbal inspiration, it should manifestly be a matter of interest to inquire what has been said, under such favourable conditions, about scientific as well as about other subjects. To the man who regards the Old Testament as a revelation in the same sense only in which we call it a testament,—viz., in so far as it bears witness of God's will and purposes towards man,—it must be interesting to note what views were held on outside subjects by writers selected to communicate God's plans to their fellow-men. And to those who, like many of the most learned Jews of the present day, regard the ancient Hebrew Scriptures only as presenting an exposition of the views of the ablest and wisest men of the ages in which its various books were composed, it is necessarily a matter of interest to inquire what the Hebrews knew, or thought they knew, about scientific matters.

For my own part, I view with interest all that relates to science in ancient writings, Assyrian, Egyptian, Hebrew, or Indian. I can not only see no reason why the passages relating to scientific matters in the Bible should not be studied in precisely the same way that we should study similar passages in Homer or Hesiod or Herodotus, but I find something of absurdity in the idea that *because*, as many hold, such passages must be pre-

* *The First Book of Moses called Genesis*, with Commentary by Dr. R. Payne Smith, Dean of Canterbury, an Introduction to the Pentateuch by the same writer, and a General Introduction to the Old Testament by Dr. E. H. Plumptre, Dean of Wells; Edited by Dr. Elliott, Bishop of Gloucester. (Cassells & Co., London.)

cisely true in every detail, therefore they ought *not* to be examined like writings which may perchance contain error. If thus true, these passages must give just the sort of information (be the amount greater or less) which science requires; if by any possibility they are erroneous (or have been erroneously interpreted), then we should adopt such a modified view of the doctrine of inspiration as will save us from the grievous mistake of attributing error (or imperfect expression of truth) to the All-Wise.

It is tolerably clear to any one who reads the first chapter of Genesis that, apart from any question of a religious revelation partially involved or implied in it, there is, underlying the whole narrative, a certain system of science. We can indeed only form a brief abstract of the science of those days from this remarkable account. For it seems to have been part of the writer's plan to avoid details as far as possible; as though he felt that, while it was impossible to speak otherwise than in harmony with the science of his day, it would be better to avoid statements too definitely in accordance with scientific views which might in after ages be corrected. Still the writer was manifestly well acquainted with the accepted scientific views of his day.

Consider, for instance, the sixth and following verses of Genesis i. We know that even to a much later age than that of the original authors of the book of Genesis (in its present form it is undoubtedly a revision and in part a compilation, as Dean Plumptre points out in the work before us) the idea was entertained that a solid partition of perfect transparency separates the waters of the sea from that store of waters above whence clouds and rain proceed. That the sun raises the vapour of water from the sea, and that this vapour becomes condensed into cloud, whence, under particular conditions, rain falls, would doubtless have seemed to them a wild and fanciful notion. Accordingly, in the ancient Assyrian cosmogony, of which fragments have been found in baked clay tablets, we recognise traces of the meteorological ideas which remained prevalent until men discovered the true interpretation of cloud and rain. The Assyrian record is far older, or at least presents ideas belonging to a far older time, than that of the writer of the Elohistic narrative in the Book of Genesis; for Sayce and Smith have traced the origin of the clay tablet literature to the Akkadians, an older race than the Assyrians, or even than the early Babylonians. (Some of the Babylonian tablets are fully a thousand years older than Assyrian copies.) But the Hebrew account, while in harmony with the science of its time, is carefully freed from definite error.* It runs thus, "and Elohim" [lit. the Powers, equivalent to Spencer's Infinite and Eternal Energy] "said, Let there be an *expanse* in the midst of the waters, and let it divide between waters and waters. And Elohim made the expanse, and divided between the waters which were beneath the expanse and the waters which were above the expanse; and it was so. And Elohim called the expanse 'Heaven.'" For "expanse" the real meaning of the Hebrew word in this account, the Septuagint has στερέωμα, which really means "a solid body"; the Vulgate has "firmamentum" which also definitely implies solidity; and both the authorised and the revised English versions have the word "firmament," which only fails to be similarly definite because it has now lost its primary significance and is understood in its applied sense only. Milton was the first to use the word "firmament" in this erroneous sense, where he sang of "the Firmament, expanse of liquid, pure transparent elemental air"; but as he knew well that the original Hebrew really signified "an expanse," which might or might not be solid, so also he knew perfectly well that the word "firmamentum" meant something not only solid but rigid. It may be said that the original Hebrew narrative, in another place, implies that the expanse was really solid; for in describing the flood, it says that "the floodgates of the heaven were opened," as though that part of the water which came from above the expanse were let out through openings in some solid partition: but we may fairly regard this as poetical. (It is followed by words which are certainly poetical; for the words translated "in the self-same day," which in the Elohistic narrative follow immediately after the words relating to the floodgates of heaven, really signify "in the *bone* of this day.")*

Compare, again, the Hebrew and the Assyrian accounts of the sun, moon, and stars. The Assyrian account is unfortunately not quite complete, but from what remains of it we see that not only was it mixed up with much belonging to some ancient system of Sabaistic worship, showing its superior antiquity (for polytheism long preceded monotheism); but it was full of details relating to the (erroneous) scientific ideas of the times to which it belonged. It ran thus:—

1. All that was fixed by the great gods (probably akin to the plural form Elohim, and not *necessarily* implying more gods than one, any more than that form does) was good.

2. He (Elohim, understood in the rest of the account as one god) arranged the stars in figures of animals.

3. To fix the year through the observation of their groupings.

4. He arranged twelve monthly signs of stars in three rows (qy. in sets of three, *i.e.*, to correspond to the four seasons—three signs to a season).

5. From the day when the year commences unto the close.

6. He marked the positions of the wandering stars (that is, of the planets) to shine in their paths,

7. That they may not do any injury, and may not trouble any one. Manifestly that they may not injure each other, or come into collision; for in the Assyrian system of astrology the malign influences of some of the planets were clearly recognised—so that they were certainly not supposed incapable of doing any harm to men and animals.

8. The position of the gods Bel and Hea (Jupiter and Saturn) he assigned

9. And he opened the great gates in the darkness shrouded

10. The fastenings were strong on the left and right

11. In its mass (that is, the lower chaos) he made a boiling

12. The god Urn (the moon) he caused to rise out, the night he overcame

13. To fix it also for the light of the night until the rising of the day

14. That the month might not be broken, and might be regular in length.

* Dr. Payne Smith and many other theologians entertain as possible the most unlikely doctrine, that the account in Genesis is an older version (of which Abraham had a copy, says Dr. Smith, *naïvely*) in his clay-tablet library, which he probably carried with him when he left Ur for religious reasons. The fact that it has been freed from polytheistic ideas proves it to be more recent than the Assyrian version.

* Compare Job xxvi. 2, and xxxvii. 18; 2 Samuel xxii. 8; Psalms lxxviii. 23.

15. At the beginning of the month, at the rising of the night,
16. His horns are breaking through to shine on the heaven.
17. On the seventh day * to a circle he begins to swell,
18. And stretches towards the dawn further.
19. When the god Shamas (the sun) in the horizon of heaven, in the east
20. . . . . formed beautifully . . . .
21. . . . . to its orbit Shamas was perfected . . . .

The rest is lost, though it may hereafter be recovered; for it is known that several copies existed of this ancient work.

In the Assyrian account there is, of course, much which is definitely inconsistent with modern science. We do not imagine that the stars were purposely arranged in figures of animals. We cannot recognise the planets as having their paths assigned to them with reference to the wants of our earth; and we should certainly not admit the possibility that our moon was sent out through the great gates enclosing the lower chaos, and there and then started (as it were from out the ribs of mother Earth), along that course whence she shines, for a few days in each month, as "the light of the night until the rising of the day."

The account in Genesis is free from these defects. It runs simply,—"And Elohim said, 'Let there be lights in the expanse of the Heaven to divide between the day and the night, and let them be for signs and for seasons, and for days and years; and let them be for lights in the expanse of the Heaven, to give light upon the Earth; and it was so. And Elohim made the two great lights,—the greater light for the rule of the day, and the lesser light for the rule of the night,—and the stars. And Elohim *gave* them in the expanse of the Heaven, to give light upon the earth, and to rule over the day and over the night, and to divide between the light and the darkness; and Elohim saw that it was good."

All this, while in perfect harmony, and clearly meant to be in harmony, with the ideas which prevailed in old times respecting the heavenly bodies, is yet not necessarily inconsistent with our modern knowledge. We may interpret the account as we interpret the words "The Heavens declare the Glory of God, the firmament showeth his handywork," which no one thinks of taking literally. It may be true that we cannot accept the account as it was understood till comparatively recent times. Knowing the stars to be orbs exceeding our earth hundreds of thousands, nay—some of them—millions of times, in volume, and severally representing energies compared with which all terrestrial things described in the first chapter of Genesis are as a grain of sand compared with the earth's mass, we cannot (if we accept the Bible account) understand it to signify that the stars were individually made and set in the expanse of heaven for no other purpose but to give light to the earth. We know, indeed, that multitudes of the stars which actually exist, probably millions for each visible star, are not lights in the heavens at all. But we may take the Bible account as telling those for whom it was written that the sun and moon, and all the stars which are as lights in our heavens, which serve therefore for signs and seasons and for days and years, are God's work, and therefore are not to be worshipped as the Egyptians and Assyrians worshipped them. Nor, while thus free from a peevish precision in our interpretation as relating to space, need we be unduly exacting in regard to time, either as to duration or as to sequence. To understand a day's work, a second day's work, and so forth, too literally in either respect, is in reality as absurd as it would be to understand God's "handywork" as something fashioned with hands such as men have. All that the account of the heavenly bodies in Genesis need be regarded as really implying is that God made those heavenly bodies which are so useful to us,—and that in the host of heaven we see *another* (a fourth, it chances to be in the narrative) of the great works of His Hand. This rightly understood, and apart from Anthropomorphic interpretations which are inherently absurd, is the teaching of Science also.

* This corresponds with my theory that the week was originally measured by reference to the half-moon phase—much more exactly determinable than the time of full moon.

MISPRONUNCIATION.

[Communicated.]

MR. ALEXANDER'S letter (1889, Knowledge, p. 185) interested me much. I give now a few more examples of words in common use amongst natives of India, but derived from English:—Colonel, ker-r-r-nal; captain, kaptán; commander, kamáneer; butler, bootrail; cupboard, kappát; glass, gilás; American drill, Merikanderil; bottle, bátli; flannel, falánin; cap, kep (*i.e.*, percussion-cap); cartridge, cartoos; pistol, pistól; line, labin; fall in, fálin; port arms, pote ar-r-rms; unfix bayonets, un*ph*ix bagnet (ph has not quite the sound of f as with us, the p is slightly sounded); shoulder arms, chodar arms; present arms, pharjant arms; bugle, beagle; box of matches, phire bokkus; doctor, dáktar; first assistant, phasht ashishtant; barrister, bálister; engineer, ejnair; library, laibri; class, kilás; lash (of a whip), lásin.

Here are some of the terms our butlers (bootrails) use:—Sponge roll (pudding), ispaurol; beefsteak, beebishtake; devilled mutton, double mutton; poached egg, pochuck; potato, batátá; claret, kilárat.

Here the names of some of my dogs with their native equivalents:—Drake, Rake: Ruby, Luby: Daisy, Lazy: Lena, Reena; Panther, Painter; Sambo, Shumbhoo (name of a Hindu god): Scamp, Iscámp; Demi (short for Democrat), Dammy; Toby, Topu (Hindustani for "a hat"); Growler, Girowe.

And here the names of some of my friends and acquaintances:—Ashburner, Arsbrune; Beaman, Beeban; Booth, Boot; Cox, Cokkus; Crawford, Crápat: Fenton, Phintan; Gleig, Gillick; Macnaghten, Megnátan; Peile, Pill: Philip, Pillick; Scott, Ishkát; Swetenham, Soolteen. (Note.—á = a in calm, palm; a = u in tub; u as u in tub; ú as oo in boot; *e.g.* crápat = *crá*, as in craft, and *pat* as put in Putney.)

Mr. Alexander might have added lakri (stick) as a word always mispronounced by uneducated Europeans as "lackry."

He is wrong in spelling it "ghárïwán"; there is no h in gári (cart or carriage).

I have heard tourists speak of Allahabad as Allerabad; and of Delhi as if it were Delhigh (as *high* tree, hill, mountain, &c.).

Káthiáwán, India, Sept. 22, 1885. C. F. G. Lester.

Darwin at Cambridge.—Mr. Grant Allen, in his admirable Life of Darwin (which will be reviewed by a kindred mind in next month's Knowledge) remarks that "fortunately for us, Darwin did not waste his time at Cambridge over the vain and frivolous pursuits of the Classical Tripos." A critic in a daily newspaper questions the taste and the English of this remark. The English rightly understood (as a University man would at once understand it) is sound enough. Of the remark itself something more may be said than that it is in good taste. It is well said! It tells a truth that much needs telling. When we think how many men that might have done useful work have been turned into mere word-mongers, doing nothing by which knowledge may be increased though some at least among them might have done much, we feel that the thought cannot be too plainly put or too often recalled. So with Mr. Allen's remark about Darwin's escape from Plato and Aristotle, and the useless—almost meaningless—mysteries of *Barbara* and *Celarent*, which might (Mr. Allen says "infallibly would") have overwhelmed him had he been an Oxford man. A little plain speaking about such matters is very much needed—and good service can never be bad form.

Our Chess Column.

By Mephisto.

STEINITZ V. ZUKERTORT.

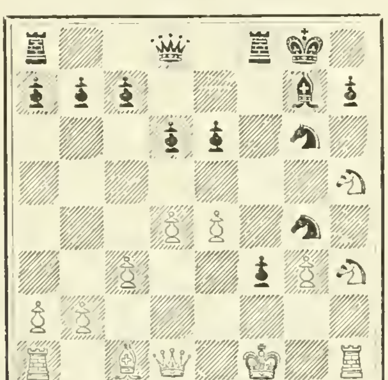
THIRTY-FIVE years ago, the late Professor Anderssen, of Breslau, won the first International Chess Tournament, organised at the time of the first International Exhibition. This victory won him the well-deserved reputation of champion player of the world. In 1858, there appeared, meteor-like, Paul Morphy, who, aided by his phenomenal genius for the game, defeated every player he met, including Anderssen. Morphy's reign over his Chess kingdom was unfortunately but brief. In 1862, we again see Anderssen coming to the fore, by winning the second London International Tournament. One of the competitors in that tournament, Wilhelm Steinitz, then came to the front, and, in 1866, he dethroned Anderssen by defeating him in a set match, of which, we believe, the result was—Steinitz 6, Anderssen 4. About the year 1870, Zukertort appeared in the Chess arena in England. In 1874, Zukertort engaged in a match with Steinitz, but the latter won by seven games to one. In 1876, Blackburne boldly threw down the gauntlet, and challenged Steinitz; but he met with even a worse fate than Zukertort. Steinitz won every game of the match.

Steinitz's title to be regarded as the Chess Champion of the World was not questioned until a few years afterwards. Zukertort, who claimed to have defeated Anderssen, also defeated Rosenthal and Blackburne in set matches, the former by seven to one, and the latter by seven to two. Of course, these two matches could not affect Steinitz's position; nevertheless, Zukertort had some fair grounds for claiming that title after the London Tournament of 1883. Although we are not at all inclined to believe that anything but a personal encounter could decide the claim of one player to be considered the Chess Champion in preference to another, especially if he has previously been defeated in a match by him; yet we must admit that not only was the London Tournament an exceptionally strong one, but the feat accomplished by Zukertort in winning the first prize, he only losing one game—being three games ahead of Steinitz—was an unequalled success, fully entitling him to the highest honours in Chess. Since that time the Chess world in general, and Steinitz in particular, wished to see a combat between these two Chess Titans. At the present moment there are fair prospects of a match taking place in America, between Zukertort and Steinitz, to decide which is the better man. The match will be for £400 a side for the first ten games, and there can be no doubt that it will eclipse in point of interest any previous combat of the kind. Whichever of the two players loses will not be disgraced, for both players have attained the highest rung on the Chess ladder, and their reputation will live on their numerous and brilliant successes of the past, as well as their analytical labours, which latter have largely contributed towards modelling modern Chess theories.

We think it will be of interest to our readers to give some specimens of the previous play between these two masters.

Position at the 18th move of a game played between Steinitz and Zukertort in 1872.

Zukertort—Black.



Steinitz—White.

White continued the game with—

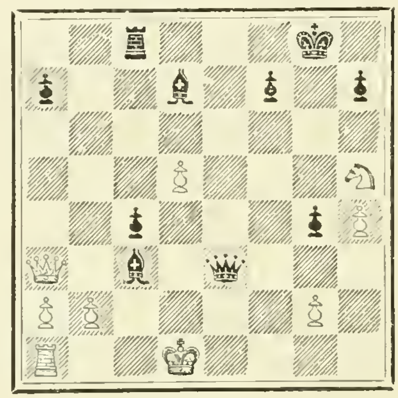
19. Kt to Kt5	B to R3 !

A subtle move, to which White makes an equally good reply. Black would win if White accepted the bait of the exchange, for after 20. Kt × P, B × B ! 21. Q × B (best), Q to K2; 22. Kt × R, Q × P; 23. Q to Q2, P to B7; 24. R to R3, R × Kt, Black has the best game.

20. Q to Kt3 !	B × Kt
21. Q × P (ch)	R to B2
22. Q × Kt (Kt4)	B × B
23. R × B	Q to K sq.
24. P to B4	P to Q4 ?
25. P to K5	P × P
26. R × P	Q to Kt4
27. P to Kt3	Q to R3
28. Kt to B6 (ch)	R × Kt
29. P × R	Q × P
30. R × P and White won.	

Position after the 22nd move of a game played in the Vienna International Tournament of 1882.

Zukertort—Black.



Steinitz—White.

The game terminated as follows:—

23. P × B.

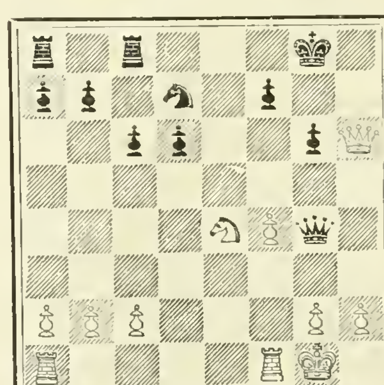
Obviously White cannot play Q × B, on account of B to R5 (ch).

	Q to Kt8 (ch)
24. K to Q2	Q × P (ch)
25. K to K3	R to K sq. (ch)
26. K to Q4	Q to K5 (ch)
27. K to B5	Q to K2 (ch)
28. P to Q6	Q to K4 (ch)
29. K × P	Q to K5 (ch)
30. K to Kt3	R to Kt sq. (ch.)

and Black won.

Position after White's 21st move of a game played in the London Tournament of 1883.

Steinitz—Black.



Zukertort—White.

Black continued with—

21.	Q to B4,

Much better than P to Q4. If Kt × P, Q to B4 (ch)!

22. QR to K sq.	R to K sq.
23. R to K3 !	R × Kt

A brilliant attack on the part of White; he gains the exchange, but puts his Q out of play.

24. R to B3 !	Q to B3
25. Q to R7 (ch)	K to B sq.
26. Q to R8 (ch)	K to K2 !
27. Q × R	Q to Q5 (ch)
28. K to R sq.	R × P
29. R to K sq. (ch)	

This was bad; R to KKt sq. was the correct move.

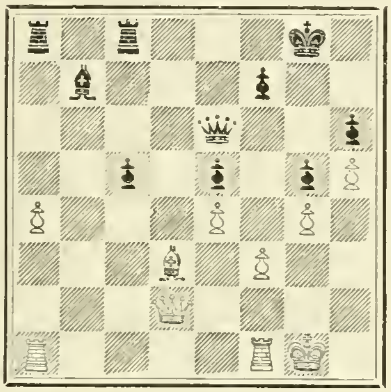
	R to K5 !
30. R × R (ch) ?	Q × R
31. Q × RP	

Curiously enough, White cannot prevent the mate, except by giving up his R

	P to Kt3
Resigns.	

Position after the 31st move in a game played in the London Tournament of 1883.

Zukertort—Black.



Steinitz—White.

In this difficult position, Zukertort won by very good strategy. White played—

32. KR to Kt sq.	P to B5 !

If, now, White plays—33. R × B, Q to Q3 [threatening Q to Q5 (ch)]; 34. R to Q sq., R to Q sq., Black gets a well-advanced and provisionally-protected passed Pawn, while White's QRP is weak. Nevertheless, we think that White ought to have simplified the game by playing 33. R × B, then, if Q to Q3, 34. R to Qsq, R to Qsq; 35. Q to K3, P × B; 36. R to Kt3, P to Q7; 37. R to Kt2, Q to Q5; 38. K to B2, and the game ought to be drawn.

33. B to B2	P to B6 !
34. Q to K3	B to R3
35. R to Kt6	R to B3
36. P to R5	QR to QB sq.
37. K to B2	Q to B5
38. B to Kt3	Q to Q5
39. B to Q5	R × R
40. P × R	P to B7
41. Q × Q	P × Q
42. R to QB sq.	P to Q6
43. K to K3	R to Kt sq.
44. P to Kt7	K to Kt2
45. K to Q2	B × P
46. B × B	R × B
47. K × P	R to Kt6 (ch)
48. K × P	R × P

and Black won. White would not have done much better if, instead of 48. K × P, he had protected the BP by K to K2; for Black replies with R to B6, and then brings up his K.

A Fool Defined.—Erasmus Darwin defined a fool as "a man who never tried an experiment in his life." There is no escape from a definition like this, as there is from such a saying as J. S. Mill's "Every fool is a Conservative." Mill could logically say it did not follow that "every Conservative is a fool,"—which, let us hope, gave great comfort to the Conservative mind. We cannot, however, say that Erasmus Darwin's definition leaves even one out who never tried an experiment; for a true definition does not err either in excess or in defect. This definition therefore asserts that every man who has tried no experiment in his life is a fool, as certainly as it asserts that no fool ever tried an experiment.

Our Whist Column.

A PROTEST AGAINST SIGNALS.

By Mogul.

As the one quality which gives Whist its greatest charm and favourably distinguishes it from Chess and Double Dummy is the exercise it affords of the faculty of reasoning from the known to the unknown, the introduction into the game of signals, which convey positive information without exercising the reason, cannot but be regarded as a great blot on, and as tending to lower the character of the game, and to make it less scientific; and Pole outrages one's common sense in calling modern Whist, when compared with the Whist of Matthews, Arnaud, Deschapelles, and others, the "scientific game," when, in fact, it is only the old really scientific game, with the addition of certain purely mechanical and unscientific dodges, for giving information known as signals. No wonder that Pembridge, in his last amusing and instructing brochure, "The Decline and Fall of Whist," which every Whist student should read, calls all the signals "wooden arrangements." The term is apt, as the veriest blockhead, after one explanation, can make and understand a signal as well as the most skilful player, for the very essence of a signal is that, by virtue of a previous convention, it conveys certain definite information, and so entirely does the meaning of a signal depend upon a prior convention, that two of the signals—viz., the Peter and the Penultimate—conveyed at one time different information to that now conveyed by them. Perhaps some readers of Cavendish will fancy that signals or conventions (for they are really synonymous terms) are extensions of principle; but they are nothing of the sort, and Cavendish's attempt to prove this is based entirely on unsound reasoning. If any one doubts it, let him carefully analyse Cavendish's chapter on the "Conversation of the Game," and he will be satisfied that the author misapprehends the meaning of the word "convention," and has false notions of what constitutes a principle, or else he would not talk of extending it as if a principle were something elastic. It cannot be too clearly understood that signals are conventional modes of conveying information and nothing else, and that players can easily invent as many of them as they like, *e.g.*, two, or more, players can agree that an original lead of a card of a different colour to the trump card should indicate a strong hand: that the lead of the smallest but one of a suit should indicate that the leader held an honour in it, that the present mode of calling for trumps should indicate a desire to be forced, and so on: and one can see how two players playing frequently together, and practising their peculiar signals, could thereby get a considerable pull over their adversaries. You (my readers) or I may consider that that would be cheating, but the inventors would, of course, deny it, and quote Clay as their justification, for does he not say, "It is fair to give to your partner any intimation which could be given if the cards were placed on the table each exactly in the same manner as the others by a machine, the players being out of sight and hearing of each other?" And could not the suggested conventions be as well played in the manner he thus specifies as fair, as any of the existing conventions? Certainly they could, and thus it comes home to us that Clay's argument, which has so constantly been relied on as establishing the fairness of signals, is unsound, and even if it be considered that he assumed that signals were only "fair" when known to or played by the other players, we should still feel—and I doubt not that every honourable man does feel—that to make use of signals against players who had never heard of them, and who, even if they had the genius of a Deschapelles, could not by any process of reasoning infer their exact meaning, would be unfair, and only a shade less unfair to use them against adversaries who might have heard of, but had never practised them, for the power of noticing the signals grows by practice, and a beginner is unable to discover them except by diverting his attention from other matters.

But, it may be asked, if conventions are both unscientific and to a certain extent unfair, how is it that any of them have been adopted? The answer is rather complex, but we can easily imagine that when such a convention as the signal for trumps was first suggested, whilst every one could see how useful it could be made, it would not at first sight strike players as being out of harmony with the spirit of the game, for after a man has played Whist for some time he draws inferences so rapidly as hardly to be aware of the process of reasoning. I must admit that my eyes were first opened as to their real character by the thoroughly fallacious reasoning of Cavendish on introducing the "penultimate"; besides, as soon as several men in a club determined to use the signal, the rest must either have declined to play with them, or else in self-defence have used it themselves; but probably

the principal reason of its being adopted was that the inferior players, always constituting a majority, would only be too glad to adopt anything which they could apparently use as well as the most gifted player. The worse the player, the less he understands or cares for the science of the game, and the more he regards it merely as a game of chance: but real lovers of the game want to preserve in it intact its power to interest us by making us reason, just as a mathematician enjoys solving a difficult problem, and hates to have the solution shown to him. These signals, however, deprive us of this interest by solving for us some of the most interesting problems that arise in the course of play; *e.g.*, one of them tells us when our partner wants trumps to be led, and another tells us very distinctly when we may, without risk, get rid of the highest card in order to unblock our partner's suit, and the very fact that it does so, is considered by its inventor and introducer as its great merit; for does not Cavendish, the arch-inventor of signals, after starting with the observation that "it has hitherto been left to the ingenuity of individuals to decide when and how to unblock their partners' suit," tell us that he has invented a signal, "the plain suit echo," to systematise the play to unblock? and thus, of course, put an end to all ingenuity in the process. Cavendish's views on signals may, I believe, be accurately stated as follows: "It is desirable to give your partner as much information as possible of the state of your hand; this or that mode of play can be utilised to give certain information. The idea is a good one, I will publish it in the *Field*, reissue the matter in a pamphlet, and then incorporate it in my treatise, which at present is a standard work; and if, after that, I can but get a few others to play it with me, we shall get such a pull by means of the information conveyed over those who will not play it, that they must follow!" At any rate, if this does not pass through his mind, it is the true history of one or two of the signals. Not one word can be found in any of his arguments that signals improve the game; but to every one who regards the game as a recreation, and not as a profession, this is the real question at issue, and the one on which I now propose to dilate.

I will assume for the purposes of argument, as is contended for so strongly by those who practise them, that signals give players who use them, an advantage over those who do not. Cavendish, in one place, calls the advantage "enormous;" but, as this advantage ceases as soon as all players use them, it can be no valid reason for adopting or inventing signals. The only reason for their introduction that I can think of is, that the conflict between rational and artificial play which they necessarily cause, as well as the additional information which they give, make the game more intricate and difficult, and thus give professors of it an increased (and, as I think, undue) advantage over amateurs; or, as Cavendish more delicately puts it: "No doubt moderate players may lack the quick perception which would enable them to take advantage of the American rules. This is no reason why better players should be deprived of that advantage!!" Certainly not, if the better players only played with their equals, or if they never played for money with the moderate ones; but some of us, at any rate, will think that after this Cavendish and the other better players who, not satisfied with natural advantages over moderate players, invent or practise artificial leads which increase these advantages, should, in fairness, give moderate players odds: and I shall wait with curiosity to hear if they do. They are making it a case of professionals *versus* amateurs. We are thus reduced to this proposition, that the adoption of signals either gives no advantage to one player over another, or an unfair advantage to the better players; if the latter, they ought to be avoided without further argument, and, if the former, there is no reason for introducing them. The game is a splendid game without them, and why not leave well alone?

One of the fairest and best tests whether signals improve the game or not, is to suppose that the construction of the game were so altered as to permit partners to give information (the sole object of signals) by showing to the table such cards as they chose, and this is just what Cavendish says he would like to do. Just consider how this most perfect way of giving information would largely deprive players of the opportunities of exercising their judgment or ingenuity. A and B being partners; A showing B King, Queen, and three small clubs; B would at once show Ace and a small one of the same suit, so that A might know that he could safely start with a small one. Again, A leading a suit, and remaining after one round with the second and third best and others, would show them, so that B, if he held the best, might get out of his way: whereupon B, if he had the best or fourth best, would at once show it to save A wasting one of his two good ones, and so on. Now would this be an improvement on Whist as it is? I think most decidedly not.

At present Whist is a pleasant recreation, whilst Double Dummy and Chess are hard work, and the suggested alteration would assimilate Whist to Double Dummy and make that a toil which is intended for pleasure; in this view I am not peculiar, for even F. H. Lewis, notwithstanding a deplorable readiness to adopt signals, says "the present tendency of Whist is to approximate the game more closely to Chess, by which Whist will lose not only its individual, but also its special educational character, and by which, as a game of relaxation, it will soon be a game of the past." This being the case, is it not the duty of every lover of Whist to resist to the utmost the introduction of new signals? and I am hoping that F. H. Lewis is taking his own words to heart, for I know that up to a very recent date he had not adopted the American leads. I could point out other ways in which signals spoil the play by diverting attention from more important points by making play slower and more laborious, and by inducing more fault-finding, for the more information is given the less scope there is for individual judgment (at D. Dummy no judgment can be exercised—the play is demonstrably right or wrong) and consequently the better player can more frequently prove, as a matter of fact, that the play of a particular card was wrong, and hence more wrangling and unpleasantness.

How much to be avoided some of the signals are, may be inferred from Cavendish's last treatise "Whist Developments," in which he explains what he calls the necessary drill for playing the American leads and the "plain suit echo." A system which requires players to go through the drudgery of reading such an inexpressibly dreary work, cannot be based on reason, nor be an improvement on the game; Cavendish really does try the staunchness of his followers in expecting them to read such a work. Its effect will, I hope and expect, be to seriously thin their ranks.

The two old signals of the call for trumps, and the return to a partner's lead, are doubtless too firmly established to be now ignored, but if the rising generation of players resolutely oppose the adoption of new signals, and give more thought to the special character of Whist, it may be hoped that these two will gradually fall into disuse, and that really scientific Whist based, and based only on rational deduction, will resume its sway, and instruct and amuse in the future even more generations of Englishmen than it has in the past.

Recent Inventions.

[*We give here a brief description of such of the many recent inventions as we think may be of use to our readers. Where it is possible the number of the patent is quoted to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane.*]

ELECTRO-MECHANICAL CLOCK.

THIS invention, by Mr. Chester H. Pond, of the United States, is of an extremely simple nature, and one which promises to prove of great service to all sections of the community. Heavy springs or weights and cumbrous gearing are essential in the ordinary clock, because it has no automatic action, but must store its power for a long period. The tension varies from a maximum—when the clock is wound—to a minimum, when it must be wound again. This gives a more or less irregular action to the mechanism of the clock, and the stress of the springs or weights wears the pinions and bearings, throws the parts out of adjustment, renders a correct time impossible, and necessitates frequent repairs.

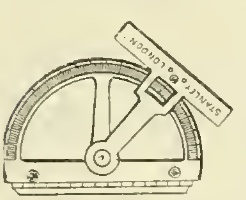
The electro-mechanical clock is an ingenious piece of mechanism, that winds itself automatically, and maintains a continuous action from year to year. It requires a small spring, but little larger than the mainspring of a watch, which is kept at a uniform tension, and acts directly on the hour-wheel, and not through a system of gear-wheels essential in the ordinary clock. This spring is wound in six seconds, and offers no interruption to the time while winding. It is kept only at a tension sufficient to run the clock one hour. It is then wound again by means of a small rotary electric motor, which is connected with the mechanism in a manner that gives to the clock a most symmetrical appearance. The electrical resistance of the coils on the motor is about five ohms. To drive it, an ordinary Leclanché cell, such as is used for electric bells, is employed. It is generally concealed in the frame or case of the clock, and is capable of furnishing the necessary current to wind the clock two years without attention. The hour-wheel, each hour of its revolution, switches the electric current through the motor, which rapidly revolves for six seconds, and communicates its rotary motion, by a gear-wheel, to the barrel on the centre arbor containing the spring. This barrel (in one revolution) imparts sufficient tension to the spring to run the clock one hour, stops the motor by breaking the electric current, and the battery rests for an hour, or until it is necessary to wind the clock again. This process is thus automatic and continuous, and the battery is used only six seconds each hour, or less than fifteen hours in a year. By this ingenious application of electricity the inventor has discarded the heavy springs and weights, and, therefore, the gearing necessary to transmit their power. He has

reduced the friction to one-ninetieth part of the amount in the ordinary clock. He has produced a more durable, accurate, and less expensive time-piece, which has also the merit of being silent in action and simple in its parts, requiring no expert to use it. If a large number of clocks are in use in one building, they can all be controlled and regulated by one clock, the battery necessary to wind up this one clock being sufficient to wind up any number of clocks in the building. The possible applications of this principle are almost innumerable. It is calculated that in the City of London alone there are 7,000 clocks wound by hand under a contract of a guinea a year per clock. The saving ensuing on the adoption of the new timepiece is apparent. The introduction of the invention to the English market has been entrusted to Mr. B. F. Watkins, of Room 29, Leadenhall-buildings.

TINNE'S COMBINED PROTRACTOR AND SCALE.

In plotting a survey, traverse, or in similar work, it is ordinarily necessary to use several instruments in succession. First, a protractor to set off the bearing or angle; then a ruler to draw the intended line: then a scale laid along the line for the distance; and then, most probably, india-rubber to erase the part of the line which has been drawn in excess of what is necessary. In each of these several settings of protractor, ruler, and scale, not only is there considerable loss of time, but also a liability to a succession of inaccuracies, in spite of wearying care in setting each instrument with exactness as regards lateral and longitudinal position and angle.

In the instrument of which we here give an illustration these sources of error and loss of time are minimised. A small stock like an inverted T slides against the edge of a T square or parallel ruler, and has pivoted to it a protractor, on the edge of which is attached by two thumb-screws one of a set of ivory part-scales. By revolving the protractor against a vernier the edge of the part-scale can be set to any angle with the base of the stock, and there clamped by a binding-screw. The whole instrument (being now virtually a set square of the exact angle needed) is slid along the parallel ruler, and the ruler run too and fro, till the zero at one or other end of the scale of parts coincides with the points from which it is desired to draw a line. A pencil is then run along the edge of the scale exactly the distance required (and, of course, at the correct angle), and the point at which it stops becomes in its turn the point of departure for the next line, after the protractor has been set to the new bearing. As both protractor and scales are numbered to read from each end, bearings can be got at any angle "all round the compass," and distances counted off E., W., N., or S., and this without the slightest necessity of considering the whereabouts of the centre of the protractor.



This instrument is the invention of, and is patented by, Mr. Theodore F. S. Tinne, formerly of Auckland, N.Z., and is made and exhibited by Mr. William Stanley, mathematical instrument maker, of Great Turnstile, Holborn.

FIRE-ESCAPE.

[Patent, No. 15,763. 1884.]—This invention, by Mr. E. H. Bayley, of 42, Newington-causeway, is one which, notwithstanding its recent introduction, has already established itself. It is based on the telescopic principle, and consists of three ladders, which, when occasion requires, are drawn by ropes and pulleys one above the other until a great altitude is attained. It has the advantage of being adjusted to any height within the extreme limits. In order to impart the necessary strength and rigidity, a specially-made steel wire rope is used above and below, while the stability is ensured by increasing the distance usually allowed between the carriage and the springs. Should any ladder-round be damaged, it can be replaced very readily, without taking the ladder apart. The apparatus is likely to prove quite as useful as a scaling-ladder as a fire-escape.

DRIVING BELTS.

[Patent No. 15563, 1884].—Mr. J. K. Tullis, of John-street, Bridgeton, Glasgow, has taken out a patent for an improvement in link-belting. In one class of the improved type the links are thinner in the centre than at the edges, an arched belt being thereby produced to suit the curve of the pulley. According to this manufacture, the entire face of the belt comes in equal contact with the entire face of the pulley. No unequal strain comes upon the rivets, as they have a level bed to lie upon. It may be made to suit any curve of pulley. This class of belt transmits, it is said, 25 per cent. more horse-power than a flat belt of the same width. A flat belt always retains a cushion of air between itself and the pulley, which prevents perfect grip. This air escapes through the spaces in the chain belt, and the edge leather takes full charge of the power which it has to turn.

Another class introduced is for half-twist belting. In using ordinary flat belts for this class of drive, it will be observed that a large portion of the belt assumes a slack appearance on the inside of the twist which leaves the pulley and does no work. Several plans have been tried to overcome this difficulty, such as splitting the belt up into two or three widths and securing them with cross connecting straps. But the most successful is the patent thick-sided and tapered chain belt. The links may be 1 inch deep at the one side, tapering to ⅝ inch deep at the other. By this formation a twist belt can be made to any width. It comes in contact with every inch of the pulley. The strain is taken up by the heavy side, the slackness is taken out, and the belt seems to work as well as if there were no twist to contend with.

AUTOMATIC PRESSURE-CHANGING GAS GOVERNOR.

[Patent No. 188.]—The principal object of this invention (by Mr. Caink, of 2, Westbourne-terrace, Malvern Link,) is to secure a means by which the pressure of gas in the mains issuing from the gas governor may be increased and diminished automatically, at such times and to such extent as the consumption of gas supplied therefrom requires, and thus prevent what frequently happens—an excess or deficiency of pressure, arising from the impossibility of the man in charge at the gas-works being able always to anticipate the precise time and extent the pressure is required, consequent on the variation of the consumption which takes place in a town from time to time.

The apparatus may be applied to any of the usual forms of governors, which are generally constructed for the purpose of maintaining a uniform outlet pressure with a variable inlet pressure and consumption.

The gas-holder of the Governor is usually provided with an air-vessel, which counteracts the weight of the holder and valve, giving buoyancy thereto. In this Governor the air-vessel is divided into a series of chambers A A', annular and concentric; the divisions which separate the chambers extend from the top to within a short distance (about ⅛ inch) of the bottom, the openings at the bottom being the only communication between the various chambers. From the top of each of the chambers rises a tube B B, extending, gas tight, through the gas-holder, and provided with a screwed plug or cap for the purpose of rendering the upper portion of the air-chamber air-tight when required. One of the legs of a syphon-pipe C C, which has the lower end of each leg turned upwards or otherwise "sealed," extends from the bottom of one of the chambers through the top of holder; the other leg extends downwards, outside gas-holder tank, and terminates with its open end on a level with the open end of the other leg of the syphon. This arrangement enables the syphon, when once charged, to remain charged indefinitely, even though neither leg may be immersed in the water. A plug may be provided at the upper end of the syphon for the purpose of charging it, or it may be charged through any of the tubes B B, &c. An annular tank D D, in which the outer leg of syphon ascends and descends, surrounds the gas-holder tank of the Governor, but is separated water-tight from it. The annular tank is charged with water to near the level of bottom of air-chamber or float in holder, when valve is in its highest position, or closed.

The adjustment and action of the apparatus are as follows:—Screw the caps on the tubes rising from air-chambers, and charge syphon. Weight the Governor so as to give the minimum day pressure desired, then charge with water the outer tank B up to the level of mouth of syphon. Remove the plugs from the tubes of such of the chambers as shall, when charged with water to the required height, add such weight to the holder as shall give the night pressure required. This will be determined by observing what depth the Governor-holder descends under the usual night pressure with an average night consumption. As the consumption of gas increases the pressure in the mains is thereby lowered, and (as is also the case in an ordinary gas governor) the holder and valve descend. The descent of the holder brings down with it the syphon, the outer leg of which becomes immersed below the level of the water in outer annular tank. The effect of this is to transmit water through syphon into such of the chambers as, by the removal of the plugs from the tubes, are in communication with the external atmosphere. The water continues to rise in the chambers until it attains the same level as that in the outer tank. Hence the greater the draught upon the mains the greater the descent of the holder, and consequently the greater the depth of water transmitted to the chambers and the greater

the pressure communicated thereto. When the consumption or draught upon the mains diminishes, the pressure therein increases, which raises the holder, and consequently lifts the water in the chambers above the level of the water in outer annular tank. The result is that water flows back from the chambers through the syphon, returning to the tank, removing the weight from the holder, and consequently diminishing the pressure. The action at first sight appears somewhat paradoxical, since the increase of pressure is made to produce a decrease, and the decrease is made to produce an increase. By dividing the air-vessel into chambers of various widths and making the proper combination, a maximum pressure of any number of tenths, depending upon the depth of the float, may be obtained. If it be desired that the pressure shall not begin to increase until the valve has opened to a given extent, it may be accomplished by lowering the water in the outer tank to the level at which it is required the increase should commence. If it be desired that the increase of pressure should cease on a given pressure being obtained, it is accomplished in the following manner:—Supposing the area of outer annular tank D equals area of gas-holder of Governor, then for every tenth of an inch of water transmitted from D to holder there will be one-tenth pressure communicated to Governor. H is a vertical pipe (reaching above level of water) in which syphon ascends and descends. J is a pipe communicating with bottom of H, having a gland at top in which a smaller pipe G, carrying a scale divided into tenths, slides water-tight, so as to be adjustable to any height. Let it be required to limit the increase of pressure to twelve-tenths. Slide G into J until its bell-mouth top is just twelve-tenths below level of water, as indicated by scale when holder is at its maximum height, that is, at the period of minimum consumption. It is obvious that when twelve-tenths depth of water, which produces twelve-tenths pressure on governor, has been transmitted from outer tank to holder, no further transmission can take place, however much farther the holder and syphon may descend, since the water, which can only reach the syphon through G, has descended to the level of top thereof. If it is desired to vary the rate of increase of pressure as the valve descends, it may be accomplished by suiting the curve or shape of the valve to the required variation.

Instead of the syphon for conveying the water from tank to annular chambers of float, a flexible pipe F may be employed.

When the apparatus has been adjusted to suit the gas supply of any system of mains, it will be seen that, with a uniform inlet pressure, a given opening of the valve will always be accompanied by the same outlet pressure; and since a given orifice, with a given pressure, discharges a certain known quantity of gas per hour, an indication either of the extent of the opening of the valve or of the degree of outlet pressure will be an indication of the rate of discharge.

CLEANING KITCHENERS.

[Patent No. 5,126 1884.]—Mr. L. Mills, of 71, West-street, Gravesend, has patented a plan for doing away with the dirty and unpleasant method at present in use for cleaning the flues of kitcheners and other ranges. It consists of a number of scrapers which are pivoted on the surfaces to be cleaned, and which are operated by handles placed in convenient places outside the grate. The scrapers, after removing the soot, automatically push open the soot-door and expel the soot.

ELECTRIC METERS.

[Patent No. 9,801. 1884.]—Mr. F. Walker, of 36, Spondon-road, Tottenham, has patented a method of measuring the strength of a current of electricity flowing through a circuit, consisting of a low-resistance series solenoid and a high-resistance shunt solenoid; the latter solenoid is movable inside the former, and passes over a fixed iron core. When the current passes, the high-resistance solenoid is drawn into the other solenoid against a spiral spring of gauged tension. A lever with its fulcrum is attached to the high-resistance solenoid, and carries a stylus which traces upon a rotating drum a curve from which the electrical energy can be obtained. In another form each of the two solenoids has a moveable iron core attached to a lever carrying a stylus. Two curves are thus produced, one indicating the electro-motive force, and the other the current strength, the sum of the two curves at any ordinate representing the electrical energy.

PURIFYING PARAFFIN OILS.

[Patent No. 13,446. 1884.]—This invention is by Mr. G. T. Beilby, of Midcalder, Midlothian. Shale or similar oils are mixed with alcoholic solution of caustic soda; this falls to the bottom, carrying with it the impurities. The supernatant oil contains an appreciable amount of alcohol, which is separated by distillation. The tarry matter mixed with the soda is steamed in a dephlegmating column to recover the remainder of the alcohol.

NOTICES.

Knowledge October Numbers (205, 206, and 207) have not been included in any monthly part, but form part of Vol. VIII., the last number containing the index to the Volume. These three numbers can be obtained either through an agent or direct from the Publisher, price 3d each, post-free.

The following numbers are out of print, viz.:—Nos. 1 to 13, 16, 17, 20, 21, 22, 23, 26, 27, 28, 29, 31, 32, 33, 34, 36, 49, 50, 51, 53, 60, 62, 63, 79. All other numbers are to be had on application to the Publisher, price 3½d., post free.

Vols. I. and II. are entirely out of print; Vols. III. and IV. (Jan. to Dec., 1883), 7s. 6d. each; Vols. V., VI., and VII. (Jan. 1884, to June, 1885), 9s. each. Vol. VIII. (now ready), July 3 to Oct. 16, 1885, 7s.

Binding Cases for all the Volumes published are to be had, price 2s. each; including parcel postage, 2s. 3d.

Subscribers' numbers bound (including title, index, and case) for 3s. each Volume; including return journey per parcels post, 3s. 9d.
Remittances should in every case accompany parcels for binding.

TERMS OF SUBSCRIPTION.

	s.	d.
To any address in the United Kingdom, the Continent, United States of America, and Canada	7	6
To Australia, New Zealand, and South Africa	8	0
To the East Indies, China, &c. (*via* Brindisi)	9	0

All subscriptions are payable in advance.

KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART

LONDON: DECEMBER 1, 1885.

THE UNKNOWABLE;

OR,

THE RELIGION OF SCIENCE.

By Richard A. Proctor.

EVOLUTION OF RELIGION.

> The Sun, the Moon, the Stars, the Seas, the hills, and the plains—
> Are not these, O Soul, the Vision of Him who reigns?
>
> Is not the Vision He? tho' He be not that which He seems?
> Dreams are true while they last, and do we not live in dreams?
>
> Earth, these solid stars, this weight of body and limb,
> Are they not sign and symbol of thy division from Him?
>
> Dark is the world to thee; thyself art the reason why;
> For is He not all but thou, that hast power to feel "I am I"?
>
> Glory about thee, without thee; and thou fulfillest thy doom,
> Making Him broken gleams, and a stifled splendour and gloom.
>
> ---
>
> And the ear of man cannot hear, and the eye of man cannot see,
> But if we could see and hear,—this Vision—were it not He?
>
> ("The Higher Pantheism") Tennyson.

IF one would mark the precise point where the idea of religion as viewed by the man of science diverges from the idea of the religionist on the one hand and of the opponent of religion (under which I include the Comtist notwithstanding his voice for the religion of Humanity) on the other, one should note it here and thus:—

The theological school regard religion as a communicated gift; the opponent of religion regards religion as belonging only to the earlier and as yet imperfect stages of intellectual development; science recognises an evolution of religion as clearly as she recognises the evolution of mind and thought.

We owe to Herbert Spencer (the first to present fully to the world of thought the doctrine of universal evolution—of which cosmical and biological evolutions are but chapters) the recognition of the oneness of method whereby men in all ages and of every race have formed such religious ideas as have belonged to their time and to their intellectual development. Where the theologian speaks of a time when to some superior kind of man the truth as to God was clearly taught, and recognises a very strong distinction between the manner in which the truly-taught and the majority of falsely-imagining men viewed the great mystery; where the opponent of religion (even when he calls himself a believer in the Religion of Humanity) speaks of the time of theological error, followed by the era of metaphysical suggestion, and by the full development of scientific inquiry, as three strongly-demarked periods of human development; the believer in the doctrine of evolution recognises one process running continuously through the whole history of the development of religion.

The doctrine of biological evolution teaches that man has developed from lower to higher animal types, from the savage to civilised man, from coarseness and brutality to purity and kindliness of conduct, thereby giving us hope for the future, instead of the utter despair which comes from the thought that having originally been created pure and perfect (save for a somewhat imbecile tendency towards disobedience) man has so changed that his heart is now "deceitful above all things and desperately wicked." But the doctrine of religious evolution speaks of better comfort still; tends to save us from a more fatal despair; for it shows men's religions developing ever towards purer and nobler conceptions, until at last all the attributes which savage races assigned to Deity have disappeared. They pictured gods as mighty men-eating chiefs, or as brave but brutal warriors. Later races have imagined one God for their one nation but that God a despot, a man of war, and unreasoning in his wrath—punishing the innocent for the guilty. Later still, advancing races have believed in a Deity who though less despotic and less insensate in anger than the special Deity of some Oriental race, they yet imagine as acting and ruling in a manner scarcely less unreasonable, and in particular as possessing—only on an infinite scale—a spirit of intolerance akin to their own. But as the evolution of religion proceeds, we see all these anthropomorphic and degrading attributes disappearing from men's conceptions of the power working in and through all things, until at length we recognise that those wiser men of old gave the true answer to the question "Canst thou by searching find out God?" when they said "As touching the Almighty we cannot find Him out: lo! these are but a portion of God's Ways; they utter but a whisper of His Glory: the thunder of His Power who can understand?" In this "confession of impotence in the presence of the Mystery of Things," we not only as Herbert Spencer points out, see "Science brought into sympathy with Religion," we see Religion cleared of "all the knots that tangle human creeds, the wounding cords that bind and strain the heart until it bleeds," we find the promise of a purifying power in humanity in regard to conduct, seeing that humanity has thus been able to purify the conception of deity which is at once the index of human character and points the way of human progress. The evolution of the religious sentiment has enabled man to pass beyond the limits which, by presenting as the best and most perfect rule something inferior even to what humanity had already attained, had checked the progress of humanity towards good. The savage cannot advance till he ceases to set his cruel god as the emblem of perfection; the civilised man cannot gain in intellectual and moral development while he worships an unreasoning Deity of ill-developed moral character (the invention of less advanced races) as the Supreme Being: in the recognition that all anthropomorphic attributes must be rejected from our consciousness of deity, lies our sure hope for the advance of humanity to all of which humanity is capable.

BIRTH OF RELIGIOUS IMPRESSIONS.

In the attempt to trace the evolution of religion we meet with difficulties not found in the study of the evolution of the body or of the mind. The body itself contains the record of the ancestral past as surely, though not so obviously, as it contains the records of its own past. We can place our finger on this bone or this muscle, this nerve or this tendon, as telling of the time when the progenitors of the human race were characterised by such

and such peculiarities. Again in the laws of embryonic development we find evidence, requiring indeed to be carefully cross-examined, but full of meaning, as to the past of our race. As regards mental development we have, apart from cerebral evidence, the evidence of material records indicating (very clearly sometimes) the intellectual capacity of our savage progenitors of various times and in various places. All these we have in addition to various forms of evidence common to all three lines of inquiry—physical, mental, and religious. But we have no material records of religious evolution akin to the bodily records of physical evolution. We find occasional indications of religious ideas in the peculiarities of the remains of structures regarded as religious, and also in the manner of burial; but such evidence is far from satisfactory.

We can learn much from such researches as have been made by Messrs. Tylor and Lubbock, and from the researches which Mr. Spencer has superintended. But what would most conduce to correct views,—evidence of the actual infancy of the religious sentiment among the ancestors of the most advanced races of our time, we want. For aught that is certainly known, the beginning of religious evolution in the leading religious races of to-day, though it may have had the same general character as that of races still in their infancy, may have differed as characteristically as the physical and mental qualities of some savage races differ from those of others, and—in all probability—from such qualities in our own human family at the beginning of its career.

Again, we may follow a method akin to that of comparative embryology. We may ask how the religious sentiment begins and how it grows in the child, and so form vague ideas as to the possible past beginning and growth of religion in the childhood of each race. But this is a method which requires to be very cautiously employed. For the child among civilised races is surrounded by influences tending to check the development of innate ideas and to replace these by imparted ideas; and it becomes very difficult to distinguish ideas of one class from those of the other. Besides, certain influences which must have been very potent in their action on the mind of our savage ancestors, have commonly no counterpart in the experience of the child. For instance, the idea of the ghosts of the dead, and of the power they might possess, would occur to a savage race, but would not present itself naturally to the mind of a child whose first nine or ten years were passed without his knowing of death. The thought of death and of its meaning, comes to the child usually when he has already received from grown persons teachings about religion.

Still, I am disposed to gather from my own recollection of my childish ideas about things outside myself and from what I have been able to learn about the recollections of others and about the ideas of those who are still children, that the ghost idea, though undoubtedly belonging to a very early form of religion, does not belong to its actual beginning, as Mr. Spencer thinks. That neither child nor savage ever actually worships natural objects or forces, is as nearly certain as any such matter can well be. Fetishism is never a first form of religious worship, and often belongs to a far advanced stage of religious development. But I believe that a form of animism not at all associated with the idea of the spirits of the dead, long precedes ghost-worship and the idea that natural objects are tenanted by the ghosts of dead persons. The child is moved by the thought that "what wells up in him in the form of consciousness" is present also in all that he can see or hear or feel wherever he instinctively recognises force—whether in the statical or in the dynamical sense, whether shown by fixity and stability, or by movement and energy. Of course, with the growth of knowledge, by which the origin of these forms of force becomes known, the child loses the idea of life and consciousness in things unconscious. But as the farther back we go in our recollection the greater the number of objects which to our child-mind seemed alive and consciously exerting force, I imagine that could we but recall our baby-mind, and read such vague fancies as take the place of thought with the babe, we should find nearly everything he sees suggestive of consciousness to the baby as he first passes the stage when

> . . . . . . new to earth and sky
> What time his tender palm is prest
> Against the circle of the breast,
> [He does not think] that "this is I";
>
> But as he grows he gathers much,
> And learns the use of "I" and "me,"
> And finds "I am not what I see,
> And other than the things I touch."

In this stage of mental growth, as thus he rounds him "to a separate mind," the child assigns to all he sees that individuality which is his recent discovery in regard to himself. He does not worship natural objects or forces, but he instinctively endows them with life—he loves them, or hates them, dreads, admires, or despises them, as if they were living things.

In this there is evidence if not proof of the vast antiquity of animism, seeing that it is innate. On the contrary we have evidence of the recent origin of the idea of creation, in the circumstance that this thought is *never* found in the child-mind except as a communicated idea. Even as communicated the child resists the admission of the idea, and often, by questions very difficult to answer, troubles the careful parent, anxious to teach him while still young an idea which the most advanced philosopher recognises as full of difficulties.

One may even say that the idea of consciousness, of innate force, which the child, so soon as he has recognised it as true of himself extends instinctively to all he sees or hears or touches, is inconsistent with the idea of creative power to which such consciousness and force are due. The child-mind thinks with Topsy, "'Specks I grow'd," "'specks it grow'd," and so forth. It is only later, when so many objects supposed to be conscious are found to have been made, that the child begins unconsciously to generalise, entertaining the thought that many if not most things have been made. Yet even then as we know from the evidence of deaf-mutes, the idea of creation does not suggest itself. In no single case has even the most intelligent deaf-mute conceived the idea of a power by which all things were made,—an idea which the theologian regards as really innate in the human mind but lost through the fall of man into sin.

There is evidence to show that as it has been with each one of us when we were passing through the childish stage of our lives, so it has been with the child-man. It seems to me that while Mr. Spencer rightly rejects the thought that nature-worship was the first form of the religious idea, while he rightly says that personalisation exists at the very outset, he is not justified by the evidence (overwhelmingly though it avails against the theories of primitive fetishism on the one hand and primitive theism on the other) in assuming that nature-worship was in all cases in the beginning the worship of an indwelling ghost-derived being. Regarding the child's idea of its own consciousness, as corresponding to the idea of the child-man about a human soul, it appears to me probable

on *à priori* grounds and consistent with all the evidence, that the religious sentiment in the savage had its beginning in the ascription of a soul or spirit to all things which seemed to possess force or energy, and that it was only later, when the ghost-theory had already attained some degree of development, that human ghosts or spirits were conceived to reside in natural objects revered or feared, worshipped or propitiated. It was however always something akin to the human soul or spirit which men recognised in natural objects, even as the child attributes something akin to its own newly-recognised consciousness to such objects. This is no "mere metaphysical assumption," as Mr. Harrison asserts, "of men trying to read the ideas of later epochs into the facts of an earlier epoch." It is the only state of religious sentiment which can be regarded as possibly antecedent to the stage of ghost-worship which Mr. Spencer has shown conclusively to be the very earliest of which actual evidence has been (or perhaps can be) gained. The simple worship of natural objects which has been imagined as the actual first stage of religion was almost a simple impossibility, certainly most improbable,—and all the evidence is opposed to the theory. But the belief in spirits animating natural objects, derived from the recognition of his own spirit and the inferred belief that each of his fellows had a spirit, was as natural in the savage, as the attributing of consciousness to the toy which he caresses or punishes is to the young child.

In this stage of the religious sentiment there is no idea of creation, still less of a Supreme Being as Creator and Ruler. Tpāi the Zulu in answer to Mr. Gardner, who asked him if he knew who made and governs the sun as it rises and sets, or the trees as they grow, presented the natural thought of the child-man, "we see them, but cannot tell how they come; we suppose they come of themselves." Nor is there any thought of a life after death. There is in fact only the sense that "that which wells up in the man himself as consciousness" is present in natural objects having apparently innate force and energy. In this sense this beginning of the religious sentiment justifies what I said at the outset,—that in all ages men have viewed religion from the same direction, from the standpoint of the known towards the domain of the unknown. They were impressed then, even as the man of science is impressed now, by the unknowable; for though what was unknown to them is known to us, it was as surely unknowable for them, as the mystery of infinite power is incomprehensible by us. In each case there has been the consciousness of mystery, in neither has there been the power of conceiving the real nature of the mystery; the finite mystery for the child-man and the infinite mystery for the most advanced scientific student of our day, have in like sort, though by no means in like degree, moved man to religious emotion.

It was, however, with the growth of the idea of the soul or spirit in man, co-existing with the body in life, continuing to exist after the body is dead, that formal religion had its origin. Such religious impressions as existed before ancestor-worship began, were but vague fancies. In them we recognise but the embryo of real religious conceptions. No mythology, no system of theology, can be rightly understood, until we have recognised how the systems of nature-worship from which all modern religions sprang (as their ceremonial observances clearly show), had in turn their origin in the worship of the spirits of departed rulers and the propitiation of the spirits of departed enemies.

Just here a thought akin to that on which those had to dwell who explained at first our kinship to the lower animals, our origin from the savage scarce better than the beast of the field and his origin from lowlier ancestors still, should be considered. Whatever opinion the unscientific may form about that particular detail of the Darwinian theory which they suppose to be the Darwinian theory itself, whatever view they may form or imagine they have formed about the descent of civilised from savage races,* they must admit that they were once children, and that the child is father to the man. If they reject with scorn the idea that their forefather the child-man held ideas about religion which seem to us now preposterous, they can hardly have quite forgotten that their original self, their child-father, entertained very strange fancies about religion. They may seem to have forgotten these fancies, but generally some faint recollection of them can be recalled; and if not, their own children will recall their own former fancies. The consideration of these wild fancies of their childhood should prepare them to admit the possibility, if not, as inquiry assures the student of science, the absolute certainty, that our savage forefathers held ideas about religion which we should regard as utterly absurd. As Mr. Spencer says, "from the consciousness of cultured humanity there have so disappeared certain notions natural to the consciousness of uncultured humanity, that it has become almost incredible they should ever have been entertained. But just as it is certain that the absurd beliefs at which parents laugh when displayed in their children were once their own; so it is certain that peoples to whom primitive conceptions seem ridiculous, had forefathers who held these primitive conceptions."

This will appear more particularly when we consider the development of men's earliest and comparatively simple religious impressions.

(To be continued.)

COAL.

By W. Mattieu Williams.

II.—THE DIFFERENT KINDS OF COAL.

THOSE who are devoted to the study of words may like to know that the original signification of the word coal was different from that which is now accepted. In the third edition of the "Encyclopædia Britannica" (1797) the article on coal commences by telling us that "Coal, amongst chemists, signifies any substance containing oil which has been exposed to the fire in closed vessels, so that all its volatile principles are expelled, and that it can sustain a red heat without further decomposition. Coal is commonly solid, black, very dry, and considerably hard. The specific character of perfect coal is its capacity of burning with access of air, while it becomes red hot and sparkles, sometimes with a sensible flame which gives little light, with no smoke or soot capable of blackening white bodies." We are further told that "Coal can never be formed but by the phlogiston of a body which has been in an oily state: hence

* Or the kinship of civilised and lower races of men. I have found that wherever the inferior races of men are well known and understood—as some Indian races in North America, some savage races in Australia, and the negro in the Southern States—the most devout believers in the verbal and literal inspiration of the Bible, reject as utterly (when pressed) the idea that they are akin to these despised races, though if they accept the Bible account they must accept that idea, as the belief that they are akin to apes, which they think the Bible allows them to escape.

it cannot be formed by sulphur, phosphorus, metals, nor by any other substance the phlogiston of which is not in an oily state. Also, every oily matter treated with fire in close vessels furnishes true coal; so that whenever a charry residuum is left we may be certain that the substance employed contained oil. Lastly, the inflammable principle of coal, although it proceeds from oil, certainly is not oil, but pure phlogiston." (Modern scientists who discuss dogmatically the properties of imaginary entities should be warned by the fate of this poor old phlogiston, or fire-ether, and study its philosophical analogy to the luminiferous ether.)

It is evident from this that, less than a century ago, the word "coal" was used among chemists in nearly the same sense as we now use carbon and charcoal. Our ordinary mineral coal was then distinguished as pit-coal, or fossil-coal, just as the French still describe it as *charbon de terre*, the German as *steinkohle*, and the Italians *carbon fossile*. We should remember that we are an exceptional people in our daily and common use of fossil fuel.

The preparation of wood charcoal is in other countries one of the great national industries. Our colliery population is replaced in Italy, for example, by the carbonari, and our "Black Country" by certain valleys into which the trees growing on the mountain are floated down or pitched down wooden slides, are peeled of their bark, their trunks cut up for timber, and their branches made into charcoal for domestic fuel. The methods of using this, and the lessons we may learn therefrom, will be treated when I deal with the sinful waste of coal that here prevails, and its coming consequences.

The fossil fuel used in this country may be divided into three kinds, the ordinary bituminous coal, which forms the bulk of the domestic fuel of England and Scotland; anthracite; and cannel coal. Besides these there are the graphite, referred to in my last, and which I need not further describe, as it is not used as fuel (excepting in the Bessemer converter), and Whitby jet, which is really a very compact and homogeneous cannel coal used for ornaments. A fourth variety of fossil fuel is used on the Continent, but is very little known in this country. This is lignite, wood-coal, or brown coal. I do not include the bituminous shales among coals, and shall treat of them separately.

If ordinary bituminous coal is distilled, *i.e.*, placed in a retort (which may be simply an iron tube or iron bottle with an outlet tube), and this retort is heated, there first rises through the outlet tube vapour of water; presently this vapour is accompanied with smoky vapour, which, when condensed by cooling, is found to be a solution of salts of ammonia, chiefly sulphate, of brown colour. The colour is due to tarry matter. As the heating continues, and the temperature rises towards a red heat, the vapour becomes more smoky and inflammable. If the vapours are cooled, we now have water, ammoniacal compounds, naphtha, and tar, with more or less of non-condensible inflammable gas, similar to that which we commonly burn.

The order of their production is that in which they are above named; they are all given off all the while under red heat; but the first named continually decrease, and the later named go on increasing as the temperature rises.

The proportions of naphtha, tar, and fixed gas vary with the temperature of distillation; the higher the temperature the greater the quantity of gas and the smaller that of the liquid naphtha. At a very high temperature the tar may be decomposed into gas and solid carbon. Therefore, in the commercial distillation of coal, where the main product demanded is permanent gas, as in our ordinary gas-works, a very high temperature is used. In distilling for liquid products the temperature is moderated. To prevent misunderstanding, I should add that though the naphtha and tar are usually described separately, they come over in this first distillation completely mixed as *crude tar*—a treacly, combustible liquid, which, by further distillation, is separable into the thick pitchy matter commercially known as coal-tar, and the limpid, liquid naphtha. By "fractional distillation"—*i.e.*, distilling step by step at gradually-rising temperatures—a number of naphthas having different boiling-points may be obtained.

These volatile inflammable distillates all belong to the chemical class of hydro-carbons, so named from their composition, hydrogen and carbon. The hydro-carbons of coal have also received the general name of bitumen, from their resemblance, when crude, to mineral bitumen. Hence the coal which contains them in notable proportion is called bituminous coal.

When these are driven off there remains behind in the retort the well-known substance, gas-coke or "fixed carbon." This, however, is not pure carbon, as is easily proved by burning it carefully. Pure carbon burns away entirely, combines with oxygen, and forms carbonic acid gas. If the coke is burned, an incombustible portion remains. This is mineral matter varying in composition with different varieties of coal. (The hard carbonaceous crust that lines the gas-retorts will be described hereafter.)

By the simple processes above described we separate the coal into three chief constituents: volatile matter, fixed carbon, and ash. It is customary to state the proportions of these in describing commercially the composition of different seams of coal. Regarded merely as fuel, this information, added to the physical properties of hardness, density, &c., are usually sufficient, but for some metallurgical uses of coal and coke further particulars concerning the quantity of sulphur (of which there is always more or less) and the constituents of the ash are necessary. To the gas-maker and others engaged in the distillation of coal a statement of the nitrogen contained in the coal is important, as upon this depends the quantity of ammonia he will obtain in the form of saleable salt, which is now an important bye-product.

I shall have to return to this subject of composition of coal again, but need not now go further into details, my present object being to render intelligible the fundamental differences between the different classes of coal. This is desirable, as I find that very few people have anything like clear ideas on this subject. The difference between ordinary bituminous coal, cannel coal, and anthracite is a mystery to most Englishmen.

Anthracite is easily understood. It is a natural coke. It differs from both bituminous coal and cannel in the absence of the volatile hydro-carbons that may be removed artificially in the manner above described. I have given some attention to the subject, and am quite satisfied with the simple explanation which attributes its formation to a natural distillation or roasting of one or the other of these flaming coals. According to this, an anthracite seam is a coal-seam that has been subjected to subterranean heat, and simultaneously to the pressure of the superincumbent rocks. We can produce artificial anthracite by distilling coal and compressing it artificially.

Anthracite differs from artificial coke only in its density or compactness, *i.e.*, the absence of that porosity which in artificial coke is due to the outflowing of the

bituminous matter, leaving these vacancies. It burns as coke burns, allowing for the difference of physical structure; a little flame is given off, but this flame is (in perfect anthracite as in completely coked coke) not a hydro-carbon, bright, sooty flame, but the pale-blue lambent flame of carbonic oxide gas, in the course of its further combustion, *i.e.*, a gas consisting of one equivalent of carbon, combined with one of oxygen, taking up an additional equivalent of oxygen, represented in chemical symbols as $CO + O$ becoming CO_2.

Most of my readers are familiar with the physical characters of anthracite: its hardness, its lustrous blackness, and the fact that, when free from dust, it does not stain the fingers as ordinary bituminous coal does. This is due to its compact and homogeneous structure, as well as to its hardness. Common coal is a medley of laminæ, or layers of vegetable material, of different degrees of hardness and varying structure, some portions being friable to the touch of the fingers.

It should be observed that no broad natural line can be drawn between bituminous coal and anthracite. Soft bituminous caking coal contains as much as 35 or 36 per cent. of volatile hydro-carbons. This is the case, or rather was the case, with the famous "Wallsend coal," now practically exhausted. Other seams of bituminous coal similarly rich in the bitumen constituents exist. They are usually soft, and become semi-fused or pasty when heated, throwing out jets of gas, which push before them the pasty coal in rounded projecting craters, and leaving a very porous coke. I once had considerable trouble in making an experimental distillation of a ten-ton sample of a remarkable coal of this sort from the neighbourhood of Ruabon, and known there as the "Wall and bench" seam. My retorts, specially constructed for obtaining liquid products from cannel and shale, were long iron chambers, with doors at both ends. The coal was charged in trays that entered at the cooler end, and were pushed forwards down the sloping chamber to the hottest or firing end, and there withdrawn on to trollies, one out at this end, and one in at the other. The "Wall and bench" coal swelled like bakers' dough, and jammed all the trays so firmly, that their release was a serious business.

My own analysis of twelve different kinds of ordinary medium or rather hard coals used at the Atlas Iron Works, Sheffield, and from as many different collieries in the neighbourhood, show a range from 24 per cent. ("Staveley Hard") to 29 per cent. ("Stone's Soft"), and an average of 26·2 per cent. and an average of 4·27 per cent. of water and ammonia in addition.

From such coal as this there is decline, without break, to the hard coals of South Wales, used in the iron-works, containing but 20 per cent. and thereabouts of hydrocarbons. In this district a very interesting and instructive gradation occurs. On the eastern extremity of the seam the coal is bituminous, fairly rich in hydro-carbons; proceeding westwards it becomes the harder and semi-bituminous "steam coal"; onward and westward it proceeds with diminishing volatile constituents until it becomes true anthracite. The same gradation has been observed in the coal-seams of the Alleghany Mountains of North America; in the great Russian coal-field lying between the Dnieper and the Don, north of the Sea of Azof, which has an area of about 11,000 square miles; and in other places.

The difference between cannel coal and ordinary bituminous coal is by no means so simple or so easily explained as that between anthracite and bituminous coal. Some of the cannels contain more volatile matter than the softest of the soft bituminous coal, but are nevertheless very hard. Besides this, the composition of their inflammable volatile constituents is different. They are hydro-carbons, but belong to quite a different series, with different properties as illuminants. The subject is interesting, and has not received the attention it deserves. I will discuss it in my next.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By Edward Clodd.

II.—The Stuff of which the Universe is made up.

THE Universe is made up of *Matter*, *Force*, and *Energy*.

I. *Matter*, under which term is comprised all substances that occupy space and affect the senses, is manifest in three states, solid, liquid, and gaseous. It is probably also present throughout the universe in the highly tenuous form called ether.

Between the above three states there is no absolute break, matter assuming any one of them according to the relative strength of the forces which bind and of the energies which loosen the component parts of bodies; in other words, according to the temperature or pressure; *e.g.*, water becomes solid when its latent heat or contained motion is dissipated, and gaseous to invisibility when its particles are driven asunder by heat.

Since the ultimate nature of matter remains unknown and unknowable, we can only infer what it *is* by learning what it *does*. The actions of bodies, whatever their states, are explicable only on the assumption that they are made up of infinitely small particles which, in their combined state as mechanical units, are called molecules; and in their free state, as chemical units, are called atoms, or elementary bodies. The molecule, which is a compound body reduced to a limit that cannot be passed without altering its nature, can be divided; the atom cannot, whence its name (Greek *atomos*, indivisible). *E.g.*, common salt, the chemical name of which is chloride of sodium, has its molecule made up of the combined atoms chlorine and sodium; water is made up of atoms of hydrogen and oxygen; plants and animals mainly of atoms of carbon, oxygen, hydrogen, and nitrogen.

The atoms or elementary substances number, so far as is known at present, about seventy, but many of them are extremely rare, and exist in such minute quantities as to be familiar only to the chemist. Perhaps we may one day find that the larger number are compounds, perhaps that there is *one* element; but the labours of many years have as yet brought us no nearer their decomposition. They are the raw stuff of which the universe is built, and however much they may vary in their distribution and their combinations, each one is unchangeable in its properties, and withal indestructible. It matters not into how many myriad substances—animal, plant, or mineral—an atom of oxygen may have entered, neither what isolation it has undergone; bond or free, it retains its own qualities. It matters not how many millions of years have elapsed during these changes, age cannot wither or weaken it; amidst all the fierce play of the mighty forces to which it has been subjected, it remains unbroken and unworn—to it we may apply the ancient words, "the things which are not seen are eternal."

The elements seldom occur in the free state, nearly all bodies being compound, or formed by the union of two or more — rarely exceeding four — elements. Oxygen, which is the most abundant and important of all, and, when uncombined, a tasteless and invisible gas, enters into nearly one-half of the crust of the globe; while of such limited variety of stuff is the infinite complexity of things in earth and heaven produced, that the mass of matter in the universe, as the spectroscopic analysis of light radiated from the heavenly bodies shows, is made up of about fourteen elements.

Our knowledge of molecules, still more of atoms, is yet in its infancy, and it would seem that particles which are beyond the range of our most powerful microscopes to reveal may be as astoundingly complex as the giant orbs of the heavens—nay, as the universe itself. Many ingenious experiments and calculations have been made to arrive at their size and structure, but they leave the problem of the ultimate divisibility or indivisibility of matter where they found it. The seven-hundredth millionth part of an inch is considerably under the thickness to which, if it could be done, a plate of zinc or of copper could be reduced without making it cease to be zinc or copper as we know and handle them. The ovum of mammals, which averages about the hundred-and-fiftieth of an inch in diameter, probably contains not less than five thousand billions of molecules. But, as showing how approximate only such estimates are, we are, in using the highest optical aid we can command, about as far from a knowledge of the ultimate structure of organic bodies as we should be of the contents of a newspaper seen with the naked eye one-third of a mile off. The only hint of a possible limit having been reached in the elements is in the invariableness of the weights in which they combine with each other. Each atom has its own fixed weight; and unites in never-varying proportions with other atoms to form molecules whose properties are unlike those possessed by the uncombined atoms; *e.g.*, oxygen in its simple state is the source of combustion, but united with hydrogen it forms water, which extinguishes combustion. Whether we take water in large or small quantities, from the clouds, or from the ocean, or from the fluids of living things, and decompose or break up its molecules, they will always be found to contain 16 parts by weight of oxygen to 2 parts by weight of hydrogen; whether we take salt from the sea or from the blood of animals, its molecules always consist of fixed proportions of chlorine and sodium, 35½ parts of the one and 23 of the other; in each and every case any excess of either element remains uncombined—left out in the cold for want of a partner.

We have now arrived at a point when the grounds for the assumptions already made—and there are others to follow,—concerning the nature of matter throughout space, whether in masses large or small, in molecules, atoms, and the tenuous ether must be stated, lest confusion arise in the mind.

If atoms are unchangeable in their properties, and changeable only in their relations through combination with other atoms, and in their distribution in space, it follows that all changes are due to motion.

Motion throughout the universe is produced or destroyed, quickened or retarded, increased or lessened, by two indestructible Powers of opposite nature to each other—Force and Energy. Each of these is a convenient term for unknown ultimate causes of certain phenomena of motion and relations between motions, but there are fundamental differences between them which require explanation to prevent confusion in thought.*

II. *Force* is that which produces or quickens motions binding together two or more particles of matter having weight, and which retards or resists motions tending to separate such particles.

When this force acts between visible masses of matter, large or small, distant or near, it is called *Gravitation;* when it acts between the invisible molecules composing masses, it is called molecular attraction, or *Cohesion;* when it acts between the elementary substances or atoms uniting them chemically into molecules, it is called chemical attraction, or *Affinity*.

As this Force inheres in, and can never be taken from, ponderable matter, every atom possesses the tendency to attract, and—in the absence of any opposing Energy sufficient to overcome such tendency — the power to attract every other atom, as well as to resist any separating power or counteracting Energy. The sum total of this Force is constant, and its several qualities are grouped under one doctrine, called the Persistence of Force.

III. *Energy* is that which produces or quickens motions separating, and which resists or retards motions binding together, two or more particles of matter or *of the ethereal medium*. The importance of these words in italics will appear later on.

The sum total of Energy in the universe is a fixed quantity, but it is not, like Force, bound up with matter so that it cannot be transferred. It exists whether it acts or not, and therefore can be stored up.

Energy is of two kinds, active and passive, or, in the terms of science, kinetic and potential. *E.g.*, dealing with masses only, potential energy is seen in a stone lying on a roof or on a mountain, in a clock wound up but not going, in a bed of coal, in gunpowder. Kinetic energy is seen in the stone falling, the clock going, the coal burning, the powder exploding. Not only does the potential pass into the kinetic and *vice versâ*, but the several forms of kinetic energy pass into one another —motion into heat, heat into electricity, electricity into heat and light and chemical action, a definite amount of any one form of energy passing into an equivalent amount of the other, the one disappearing as the other appears. And the tendency of all passive energy is to be converted into active energy until a dead or uniform level is reached, as in bodies of the same temperature wherein no differences of separating power remain. The significance of this will be more apparent when the ultimate destiny of the universe is considered.

The qualities of convertibity and indestructibility are grouped under one doctrine, called the Conservation of Energy.

The Persistence of Force and the Conservation of Energy may be grouped together under the doctrine of the Indestructibility of Power.

Force is the attracting power; Energy is the repelling power; and by the antagonism of these the work of the universe is performed. Every mass pulls every other mass by the force of gravitation—the earth the moon, the sun the earth, some other star the sun, and *vice*

* If the readers of Knowledge find their conception of cosmic relations made clearer by this paper, their thanks are due to Mr. Grant Allen, not to me. His interest in this effort of mine has taken the generous form of lending me his unpublished notes on this subject, and these are so important and satisfactory a contribution to theories of the dynamics of the universe that it is to be hoped Mr. Allen will speedily give us a book that I venture to think will correct and supplement the current manuals, none of which are altogether free from confusion in statements of the relations between Force and Energy.

versâ. And the moon would fall to the earth, as also the earth to the sun, but that the energy of their orbital motion overcomes the force. When a loaded waggon is pulled, especially uphill, the muscular power which, in the form of kinetic energy, is expended by the horse, overcomes the attractive power inherent in the earth to draw the waggon towards its centre and keep it there. When the energy of heat which drives asunder the particles of bodies, changing them from the solid to the liquid or gaseous form, is expended, then the particles resume the solid form in virtue of the attractive force of cohesion.

If Force had unresisted play, all the atoms in the universe would gravitate to a common centre, and ultimately form a perfect sphere in which no life would exist, and in which no work would be done. If Energy had unresisted play, the atoms in the universe would be driven asunder and remain for ever separated, with the like result of changeless powerlessness, as in the case of force alone. But with these two Powers in conflict, like the Ahriman and Ormuzd of the old Persian religion, the universe is the theatre of ceaseless re-distributions of its contents, whether in the sweep of the stars and their attendant systems through space, or in the pendulum-like vibrations of the invisible particles of every body, or in the throbs of the ethereal medium. So rapid are the motions, the rebounds between each molecule in hydrogen gas numbering seventeen thousand millions per second, that even if the molecules were within microscopic range we could not see them ; and yet these collisions themselves are few compared with the oscillations of light waves, which number hundreds of millions of millions in the same time.

Such action shows that, just as there are spaces or distances between the stars measureless in their vastness, so there are pores or spaces between the molecules of bodies, and between the atoms which compose the molecules, measureless in their minuteness. And, if added proofs of these inter-molecular spaces were needed, we find them in the contraction and expansion of bodies through the quickened or retarded vibrations due to the separating energy manifest as heat ; in the compressibility, although slight, of liquids; in the liquefaction of the so-called permanent gases, oxygen, hydrogen, and nitrogen under extreme cold and pressure ; in the partial solidification of hydrogen, the lightest body known, so that it falls on the floor with the rattling noise of hail.

But more than this. These pores between invisible particles ; these spaces between star and star, spaces so vast that the diameter of the earth's orbit, one hundred and eighty-eight millions of miles, seen from the nearest star, is but a pin's point, are not vacant. Speaking of the force of gravitation, Newton said that to conceive of one body acting upon another through a vacuum, is so great an absurdity that no man who had "in philosophical matters a competent faculty of thinking" could ever fall into it.

And the like applies to the transmission of light, heat, and other forms of energy between bodies far and near. For the explanation of these varied, and yet related, phenomena, it is a necessary assumption that the minutest intervals between atoms, as well as the awful spaces of the universe, are filled with a highly-rarified, elastic medium called ether, which, ever tremulous with unentangled vibrations, is the vehicle of energy, alike from the infinitely great and the infinitely small.

That matter should be unseen and unfelt is no new conception to us. Its existence in an ultra-gaseous state, as proven by the action of molecules in tubes where as high a vacuum as seems possible is obtained ; its invisibility in air—the vehicle of sound—in steam, and in substances vaporised by the voltaic arc; its extreme rarefaction in such bodies as comets, the stuff of whose tails, spreading across millions of miles, could be compressed into a small vessel, prepare us to conceive unseen realities. Thus, where the sensory organs are powerless to report the facts, science, excluding no faculty from wholesome exercise, bids Imagination use her larger insight to make clear the significance of the things which eye hath not seen nor ear heard.

The value of the foregoing exposition, in itself little more than an abstract, of the relations between Matter and Power, will be proved or disproved in the degree in which it squares with the phenomena to be described and accounted for in subsequent chapters. Meanwhile, the subjoined tabular summary may set the subject in a clearer light.

MATTER.	POWER.		
	FORCE.	ENERGY.	
		POTENTIAL, OR PASSIVE.	KINETIC, OR ACTIVE.*
Masses	Attraction between Masses, or Gravitation	Separation of Masses (commonly called Visible Energy of Position) Ex. Stone on a roof A head of water	Motion of Masses Ex. Moon's motion round the earth Stone falling Water falling
Molecules ..	Attraction between Molecules, or Cohesion	Separation of Molecules Ex. Steam	Motion of Molecules Ex. Steam condensing into liquid Heat-vibrating particles of a poker
Atoms	Attraction between Atoms, or Chemical Affinity	Separation of Atoms Ex. Atoms in a free state	Motion of Atoms Ex. Atoms rushing to form molecules
†Electrical Units	Electrical Affinity	Separation of Positive and Negative Electrical Units Ex. A thundercloud and the earth	Motion of Electrical Units Ex. Electric current
Ether (?) ...	(No evidence of aggregating power inhering in it.)		(All Kinetic Energy, except the small proportion intercepted by bodies in space, passes from matter to the ethereal medium. This is the doctrine of the Dissipation of Energy)

* Each kind of Kinetic Energy has separative, combining, and continuous or neutral motion. Example of Separative—a stone thrown upwards; example of Combining—a stone falling ; example of Neutral—a top spinning in the same place.

† This concept of electrical units, which may be the equivalent of polarity of the atom, is here added merely as a convenient mode of envisaging a certain order of phenomena.

THE NEW STAR IN ANDROMEDA.

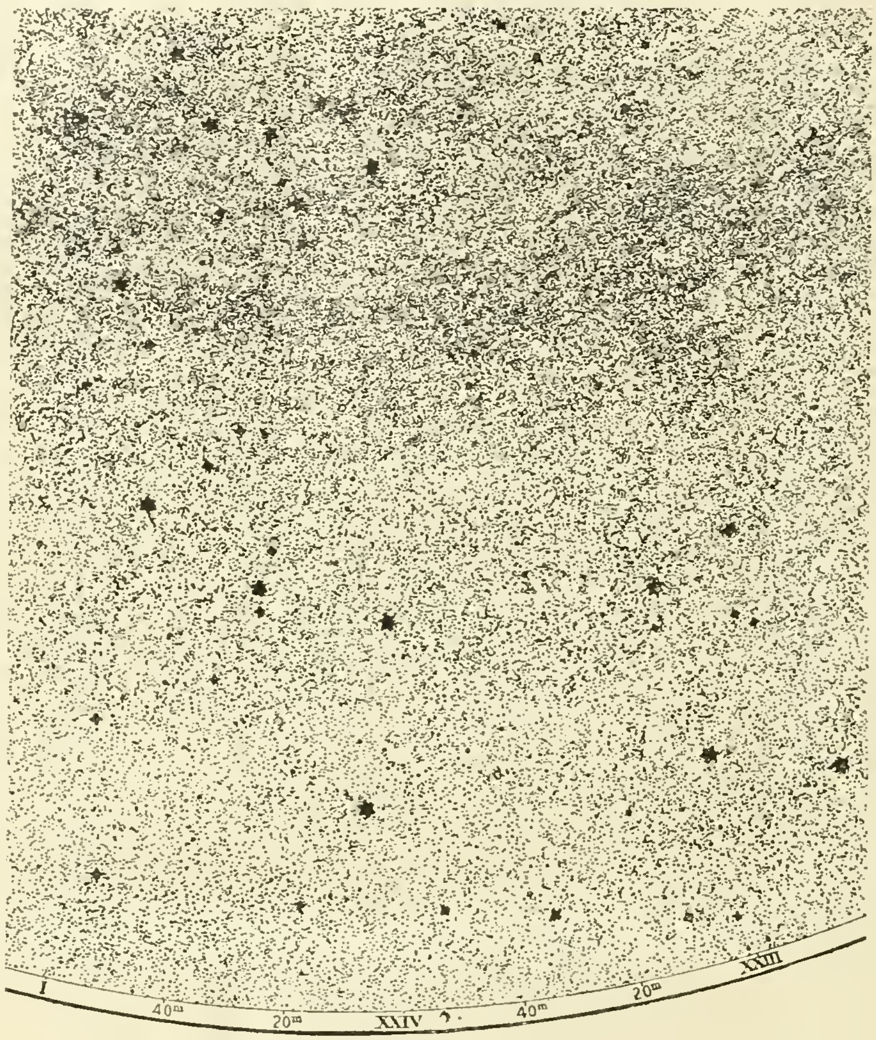
By Richard A. Proctor.

A STAR recently made its appearance in the very heart of the most remarkable star-cloud in the heavens. It appeared not far from the spot where some looked for the return (the sixth triennial return as they believed) of the "Star of Bethlehem." I propose here, briefly to consider the import of this strange phenomenon.

In the days before the telescope, astronomers reckoned among the heavenly bodies five star-clouds,—the Pleiades in the Bull, Præsepe or the Beehive in the Crab, the cluster in the sword-hand of Perseus, the nebulous patch around the sword of Orion, and a faint streak of light just outside the northern edge of the waist of Andromeda. Of these, the two last only are what we should now call nebulæ,—but nebulæ of two distinct kinds. How with the invention of the telescope the number of nebulæ increased is related in books of astronomy. Late in the

eighteenth century Messier published a list of 103. Then began the work of William Herschel, who swept the northern heavens with his great gauging telescope, sending in to the Royal Society two lists of a thousand each, and then a supplementary list of 500. John Herschel followed in the same work. First surveying the northern hemisphere to accustom himself to the methods of observation followed by his father, he then went to the Cape, and there completed the survey of the whole star-sphere. Over 4,400 star-clouds were discovered by these two great astronomers,—the total number now known being about 5,000.

The grand idea was thrown out, first, I believe, by Wright, of Durham, that these star-clouds are external galaxies like the system of stars of which our sun is a member. Sir William Herschel early adopted this view. But he also early modified it in a way which few readers of his papers seem to have noticed. For he recognised many of the star-clouds as parts of our own galaxy, broken up in long-past æons. Then later, he noted a distinction between the various orders of nebulæ, which led him to separate one large class as probably not star-clouds at all, but rather great masses of self-luminous vapour. Still he retained even to the last the belief that among the nebulæ are some which really are external galaxies. Sir John Herschel, while recognising strong evidence against this belief, definitely pointing out indeed the most striking fact of all those which oppose the doctrine, retained it as a possible hypothesis, and even noted those among the star-clouds which seem to resemble our own galaxy most closely.



Section from my Chart of 324,198 Stars, showing where the New Star appeared.

(For Key, see Opposite Page.)

Mr. Herbert Spencer was the first to show that the doctrine of external galaxies—at any rate, as that doctrine had been propounded by Arago, Humboldt, and some others—is inconsistent with observed facts. In particular, he called attention to two very striking objections, one indeed fatal, the other presenting very strong probabilities against the theory that the nebulæ are external to our system.

Sir W. Herschel found, late in his career as an observer, that even his most powerful telescopes would not fathom the profundities of some parts of the Milky Way. With each increase of telescopic power more and more stars came into view; but also new areas of nebulous light appeared, which only higher powers could resolve into stars. Of those depths, Herschel said that they were (for his telescopes at any rate) "altogether unfathomable." If then regions within the bounds of our stellar system, are unfathomable, so that the stars composing them cannot be individually seen, how utterly impossible must it be for the same telescope to resolve into stars, or even bring into view, galaxies lying far beyond our own? If for instance the nebula in Andromeda, which just now attracts so much attention, is an external galaxy, then its apparent size shows that it must lie at a distance about three hundred times greater than its own greatest diameter. The unfathomable parts of our galaxy lie less than half its diameter from us. If then the Andromeda nebula is of the same size as our galaxy, it lies about 200 times farther away than those regions which Herschel's most powerful telescope refused to resolve, and failed in part even to see. This of course leads to an obvious absurdity. But if, on the other hand, the Andromeda nebula is no farther off than the parts of our galaxy to which Herschel's telescope reached, then it is necessarily an object very different from our galaxy, having less than the 200th part of its diameter, and less than the 8,000,000th part of its spatial extent: moreover lying at that small distance it must be regarded as belonging to the same region of space, and therefore to the same system.

The other argument, rightly understood, is almost equally convincing. Whenever Sir W. Herschel found he was approaching regions where stars were few,—poverty-stricken regions—he used to call to his sister, Caroline Herschel, who acted as his assistant, "Prepare to write: nebulæ are approaching." He recognised that nebulæ occupy spaces where stars are wanting. This agreement can be no mere chance. Necessarily then the

Key to the Map of Many Stars given on opposite side.

The Great Nebula in Andromeda.

nebulæ are part of our galactic system. One may compare the case to what might be observed by any one looking at our solar system from some vast distance, but with power to see its smallest individual components. Such an observer would find the asteroids numerous between the regions where the two families of planets the giant planets and the terrestrial planets—pursue their separate careers. If he failed to notice how precisely the ring of asteroids appeared to occupy the mid-zone between these planetary families, he might very well fall into the mistake of supposing that the ring of asteroids was a remoter family of planets, severally having (on the average) as great a bulk as the terrestrial planets, or even as their giant brethren. Nay we can imagine him falling into a more complicated mistake, and setting the terrestrial planets farther away than the giant planets, and the asteroidal family much farther away still. But if, continuing his observations, he noted the exact agreement of the asteroidal zone with the space where separate large planets were not travelling, and if further he had some idea of the laws of probabilities, he would at once assign to the asteroids their true position as parts of the planetary system. So, as Mr. Spencer long since pointed out,* we must unhesitatingly regard the nebulæ as parts of that system to which the separate stars belong with whose groupings their own so exactly fit.

But precisely as the leaves and branches of a tree occupy different regions, if we consider the tree in detail, while they occupy the same region if we regard the tree as a whole, so, if there were any part of our galaxy so separate from the rest that we could view it from outside, we might expect to find stars and star-clouds intermixed within it. It so chances that there are two such regions, the Greater and Less Magellanic Clouds. In these we find stars of all orders from the seventh down to irresolvable stellar nebulosity,—just as we should in the richer regions of the Milky Way, if these were removed so far away that the brightest stars in them were reduced to the seventh magnitude. And precisely as that would bring the star-clouds (now, from our inner standpoint, seen away from the galaxy) into the same field of view with its streams and branches, so do we find the Magellanic Clouds containing all orders of nebulæ.

While then I would regard the more diffuse parts of the Milky Way as belonging to portions of our stellar system in the midst of which our solar system lies, and the better defined parts in the southern heavens as portions farther away, I regard the Magellanic Clouds as portions much farther away still.

So much I have long maintained. But now the appearance of a new star in the great Andromeda Nebula emphasises the evidence already sufficient to show the general nature of our galaxy. On May 9th, 1860, before astronomers had begun to study nebulæ and stars with the spectroscope, a star of the seventh magnitude shone out in the midst of a nebula in the Scorpion, or rather in place of it, for while the star was shining the nebula was unseen. As the star faded away the nebula (80 Messier, almost midway between α and β) *a star-cluster*, one of those referred to by Sir John Herschel in his letter to me (see last number) resumed its normal appearance. In 1873, a star appeared in the midst of a *planetary nebula*—before unknown—in Cygnus; and again as the star died out the nebula became visible. In the great Argo Nebula a star nominally of the seventh magnitude shone out as a star of the first magnitude, and then faded out of view, the nebula becoming apparently more conspicuous as the star faded. Of all the so-called new stars which have been observed since the matter could be tested, only one, the new star in the Northern Crown, was not associated with any recognisable nebula. So again every new star, except the last-mentioned, has appeared close by the Milky Way, and generally on its borders—and even the star in the Northern Crown lies in a region towards which milky star-streams extend.

This being so, I imagine no one with any power of forming a philosophic opinion, doubted the physical association between the new star in Andromeda, and the marvellous nebula in whose midst it has appeared. Even those who thus doubted, had their doubts removed,—at least I should imagine so (speaking always of persons possessing reasoning power) when it was found that in the main the spectrum of the new star was the same as the highly-characteristic spectrum of the nebula. (There was no fear of confounding the two spectra together.)

This being so we have every reason for inferring that the new star appeared in a part of the galaxy which is probably the nearest to our solar system. In this part from Orion to Cepheus, the five nebulæ visible to the naked eye are all found. Two are shown in the illustrative maps, and these objects are probably as near to us as the lucid stars are (*i.e.* those visible to the eye), on the average, if not nearer.

The picture of the Andromeda Nebula is from the view made with the Harvard telescope by Trouvelot. The new star is not quite central, but it is in the very heart of the nuclear region of the nebula.

* In 1869 in my "New Theory of the Universe" I pointed to the same evidence, not knowing that Mr. Spencer had earlier called attention to it. This I mention, partly for the purpose of handing over to the proper person such credit as may be due for the recognition of the force of this piece of evidence, partly to show that the force of the evidence once noted is unmistakable.

As a memorial to the late Sir Titus Salt, and in recognition of his benefactions to Saltaire, the Governors of the Salt Schools have decided to build a new Science and Art School, costing about £6,000. The building will be completely finished by May 15, on which day will be opened an important Exhibition on the lines of the late International Inventions Exhibition.

"No one," says Buckle, "can have a firm grasp of any science, if, by confining himself to it, he shuts out the light of analogy. He may, no doubt, work at the details of his subject; he may be useful in adding to its facts; he will never be able to add to its philosophy. For the philosophy of every department depends on its connection with other departments, and must therefore be sought at their points of contact. It must be looked for in the place where they touch and coalesce—it lies, not in the centre of each science, but on the confines and margin."

Moderate Drinking.—It is high time, says the *Lancet*, to define what moderate drinking is not. It is not drinking in public-houses; it is not drinking on the sly; it is not drinking early in the day; it is not drinking by itself at other than meal-times; it is not drinking to procure sleep or to relieve pain. All men, and especially all women, who do such things are not moderate drinkers, and had better beware. A moderate drinker takes a very limited quantity once or at most twice a day, with food, such a quantity as does not make him stupid or even sleepy, such as leaves him cool and unexcited. The moderate drinker takes the lightest forms of alcohol, and takes even these with care. He knows the power of alcohol to produce disease, and is on the look-out for any indication of harm or excess. We do not think it proved that such persons become drunkards. It is terrible, however, to see how soon a drunkard is made by thoughtless drinking, and how complete is his physical destruction often before he, or perhaps she, comes under medical notice. Jaundice, or dropsy, or albuminuria, or delirium tremens, may have been reached before friends, unwilling to admit what they fear, will send for the medical adviser and make a clean breast of it. Alongside all the teetotalism that exists, there is still an appalling amount of tippling which does not distinctly intoxicate, but saturates the principal organs, and destroys them more quickly than an occasional debauch. But, as we have said, this is not moderate drinking—it is mortal drinking.

PLEASANT HOURS WITH A MICROSCOPE.

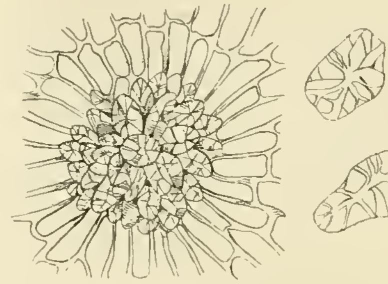
By Henry J. Slack, F.G.S., F.R.M.S.

AT this season of pear-eating every one becomes acquainted with the fact that this delightful fruit contains, besides the luscious, succulent matter, some gritty stuff, especially near the core, but only those who have examined it under a microscope have any idea of its interest and beauty. The bulk of a good pear consists of thin cells filled with the fruity material which is readily digested; the gritty matter called *sclerogen*, or hard tissue, is as indigestible as bits of tough wood, but useful as a mechanical stimulant of the intestine. In the formation of a plant-cell the first process is the deposition of particles to make a thin, delicate tissue. This, when required, is thickened, not by simple additions of layer upon layer, as successive sheets of paper might be stuck together to make a strong body, but by the newly-formed tissue taking in fresh molecules. In many cases all that a plant requires for some of its cells is that they shall be able to hold living soft matter, and carry on processes of endosmose and exosmose—in and out passage of fluid matter—through their delicate walls. Minute differences in the arrangement of the cell molecules, which utterly baffle microscopic investigation, invest cell walls with varying properties, which enables them to give a preference to the entrance or exit of different materials, and to act with different degrees of velocity.

Besides cells containing living and active matter, plants require to be strengthened, so as to give firmness and support; others to unite and construct vessels and pipes of different sorts; some kept open by spiral fibres, like the wire inside flexible gas-pipes; others to be hardened by special deposits.

The growth of these various cells occurs through the activities of matter containing a large proportion of water. Every structure is built up with particles rendered mobile by fluids, and, as many minerals cannot crystallise without taking up a definite quantity of water, called water of crystallisation, so plants in forming organs need what has been called water of organisation, in this respect resembling animals. When a hard tissue is formed, none of the strong matter is deposited without the help or agency of soft matter. The process is not like sticking a layer of wood on to a soft one of cotton, but one in which soft active matter becomes penetrated by the firmer particles. Plant-growth takes place in two or more definite lines of direction, and not in one only. Here we find a process like that of mineral crystallisation, in which molecules are built up in patterns determined by the directions in which the cohesive and repulsive forces operate.

If we cut a little piece out of a pear, near the core, we are sure to find a considerable number of the sclerogen cells, aggregated in little masses, some the size of a small pin's head, others much less. The biggest are formed by the coalescence of a considerable number of the smaller ones, and look much like imperfectly-crystallised milk-sugar. The smallest are composed of a multitude of cells, very hard, transparent, like glass, and exhibiting, when magnified, branching canals. Each hard cell is surrounded by a fringe of thin, delicate cells, seen to be pitted when magnified two or three hundred times. The annexed figures, borrowed from Quekett, show the character of the two kinds, and the observer should compare the sclerogen cells with those of the bone of any mammal, which they somewhat resemble.



A small piece of pear full of these sclerogen cells should be boiled in water for some time. When the pulp is very soft, the sclerogen masses are easily picked out with needles, and should be well-washed to remove the succulent matter. Examined in this state under a power of about fifty linear, they might be taken for aggregations of imperfect crystals. They should then be crushed in a small pestle and mortar if one is at hand; if not, wrapped in paper and pressed hard with a knife-handle. If an attempt is made to crush them with a knife-blade they will start off, as both they and the knife are elastic. The crushing should be done without much grinding, or the specimens will be spoilt. When broken up, the particles should be examined with a hand-magnifier, or a dissecting microscope, and a dozen or so picked out which have been separated from the mass without injury. These can be mounted in Canada balsam, and are well worth preserving. By transparent illumination the fine canals look dark, by dark-ground ditto they come out light and glittering.

The function of the sclerogen masses seems to be that of strengthening the surroundings of these ovaries, and protecting the seeds. A similar growth of sclerogen gives hardness to the shells of stone fruit.

The student should make sections of peach-stones and similar things, and examine those of the ivory-nut; the fruit of *phytelephas macrocarpa*, a pretty palm-like plant, the ivory tree of S. America. The compound teeth of some animals, such as the Cape ant-eater (*Orycteropus capensis*), and of the rays afford instructive comparisons. The ivory tree (*Plytetephus*) is hardened albumen. It is soft when the nut is fresh-gathered. The meat of the cocoa-nut is a similar structure with the hardening not carried beyond the tough state. Thin sections of pear-seeds should be examined. Their albumen is comparatively soft, and its cells very different from those of the sclerogen.

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

COLOUR AND LIGHT.

WE have seen how what we call white light is really composed of a mixture of coloured lights; such colours having their origin in the length of the æthereal waves which produce them; and in Fig. 2 (p. 16) we have represented the chief or most salient colours of the spectrum as consisting of violet, blue, green, yellow, and red. These were long considered as primitive or undecomposable colours. By-and-by, though, we shall see that (to adopt a phrase from arithmetic) we have not even yet reduced

our spectrum to its lowest terms; and that in reality three colours, and three only, in various combinations, go to make up the hundreds of thousands of compound tints and hues which glorify the face of nature. For the present, disregarding any intermediate shades, we will deal, for simplicity's sake, with the spectrum of the five colours which we have specified above; regarding them as pure when produced by the projection by a prism of the image of a narrow sun-lit slit. The effect of the mixture of white light with any of them we shall see immediately. This much premised, we will endeavour to investigate the different ways in which the colours are produced which we see around us. With two of these ways we have already dealt in this series of papers. Interference was treated of on pp. 319 *et seq.* and 540 of Vol. VII. of the weekly issue of Knowledge; and polarization referred to on p. 307 of Vol. VIII., and again on p. 17 in our November number. It is though scarcely necessary to add that the colours due to polarization are never seen under ordinary circumstances, and require special apparatus to exhibit them. We here propose to treat of reflection and absorption.

Now our first experiment shall be made with a tumbler of clean water and a little milk. In the outset, if we let a beam of light fall upon the surface of the water at any moderate angle, we know that part of the light will be reflected and part will pass through the water; both transmitted and reflected light being alike colourless. Let us now, though, add a little milk to the water and let us look down upon it. The reflected light will no longer be colourless: it will exhibit a decided bluish tint —a fact popularly recorded in the slang appellation of "sky-blue" to the watered milk of the respectable English tradesman. From this it is obvious that the minute globules of milk diffused throughout the water reflect the blue rays out of those composing the white light which falls upon them, and in some way absorb or suppress the rest. But suppose that, instead of looking down on to the surface of our milky water, we look through it—what then? Shall we see the transmitted light of a blue tint? Not at all. It will, on the contrary, appear yellowish. Thus it is evident that under certain circumstances, milk, in a fine state of subdivision, divides white light into yellow and blue light. It is almost needless to add that if we continue to add more and more milk to the water, the blue tinge will give way to a white one; though it may not be quite so familiar a fact, that the light passing through the mixture will, as the milk increases in proportion, become yellow, then orange, and finally red, prior to the opacity of the milk becoming so great as to shut out all light whatever.

Analogous phenomena are exhibited by wood smoke issuing from a cottage chimney, which, as everyone knows, shows as of a pale bluish white as seen against a dark background of trees, but appears brown against the light of the sky. It is, however, the sky itself which exhibits this phenomenon on the grandest scale. Space itself is of inky blackness, and the records of aërial voyages show what an awful dark appearance the celestial vault presents when the aëronaut attains any very considerable height. The fact is, as has been so admirably explained by Tyndall, that our atmosphere is filled with innumerable billions of particles so minute that they never descend to the earth's surface at all; snow, hail, wind, and rain being alike inoperative upon them. Now when the sun lights these particles they behave in a fashion cognate to that of those of milk in our little experiment just described. They reflect blue and white —or white and blue—light, and this, seen on the black background of space, we see as the familiar blue of the sky. The nearer we are to the earth's surface, the more we get of the white element and the paler the sky tint. If, however, the sky is clear, and the sun is at any considerable height, the yellowish tint produced by the transmission of his rays through the particles of our atmosphere is scarcely noticeable save in his immediate neighbourhood. When, though, he approaches the horizon, his light has to pass through a greatly-increased thickness of the atmosphere and its contents, for a reason which a moment's study of Fig. 5 will render apparent. Here E represents the earth, A an observer on its surface, the white ring surrounding the earth indicating the atmosphere. If now the sun, S, is in the zenith of the observer—*i.e.*, right over his head—its light has only the thickness A B to penetrate. When, however, the sun is setting, as at S', its rays have to travel through the whole thickness, A B', of air, with the familiar result that as the Sun descends he first looks yellow, then orange, and ultimately when on the horizon fiery red. The reader who has made the little experiment with milk and water described above will now have no difficulty in accounting for this sequence of phenomena for himself.

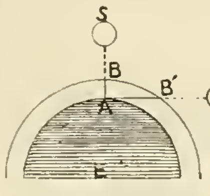


Fig. 5.

Moreover, a little consideration will show that in the gorgeous and glorious chromatic effects of sunset, both reflection and transmission play their parts. What artists call the "warm" tints for example, the crimson, orange, and yellow, have their origin in transmitted light. The violet, greyish, and steel-blue of the higher sky depend more or less upon reflection, while many intermediate tints are produced by a combination of both. It is not however only at sunrise and sunset that the effects of our atmosphere in the production of colour are rendered apparent. They become particularly marked in clear weather at any hour of the day when we regard the remote distance. Let us take a range of distant mountains as a familiar example. We know, as a matter of fact, that they may consist of bare reddish feldspar, of almost black trap rock, or may be clothed with a carpet of exquisite verdure; but, owing to the miles of intervening air, teeming with its invisible particles, the proper colours of the remote hills are shrouded and veiled, and we see them as of a deep and almost aërial blue or purple. Light and shade, as such, almost disappear, and the summits, peaks, and ridges stand out as though composed of the crystallised material of a cloud. In the middle distance of the landscape, where, of course, the thickness of the veil of light-scattering particles is notably less, the blue atmospheric tints blend with the proper colours of objects, and tend to reduce their luminosity and impart a greyness to them; while as we approach the immediate foreground the local colour of objects becomes more and more pronounced, until they become, practically, pure immediately under the eye of the observer.

The vast importance of a knowledge of these rudimentary facts to all engaged in the art of landscape-painting, whether in water-colours or in oils, as amateurs or professionals, can scarcely be over-estimated. Upon such knowledge depends the power of rendering the varying aspects of any given view with a natural effect. The beginner who neglects to represent the charming influences of the atmospheric transmission and reflection of light, must perforce fail to produce anything approach-

ing to an accurate representation of a landscape. He knows that a field three miles off is green, and he paints it approximately of the green which it appears *when he is in it*. If he would, as Ruskin recommends, cut a hole in a card, through which he could see it, and try to match its tint exactly from his colour-box, he would find, perhaps not a little to his surprise, that it would be in reality rather grey than green at all. We have said this much to show that the question of colour has a practical as well as a merely theoretical or speculative interest. Let us proceed to deal more at length with the production of colour by absorption.

Now it is to absorptive phenomena that practically all our ordinary colours are due. The scarlet of the geranium, the green of the grass and trees, the blue of the artilleryman's coat, the grey of the rocks, the gorgeous hues of the cathedral window, and the range of pigments on the painter's palette,—one and all have this origin. Let us endeavour to gain some idea of absorptive action by the aid of a simple experiment. We must obtain a piece of coloured glass—say blue or red, it matters nothing for our present purpose which. Now let us lay it upon a piece of the dead black paper which we have used in constructing some of our earliest-described pieces of apparatus, and view the reflection either of a candle or of ordinary daylight from its surface. What shall we see? Simply an image of the reflected object in its natural colours, as though, instead of a deeply-tinted reflector, we were employing an ordinary piece of white plate-glass. But if, instead of viewing a reflected image in this way from our piece of, say, red glass, we look through it, we shall see that the source of light, so regarded, will appear red. Now, what has happened? Has the glass actually changed the essential quality of the white light, or what? The arrangement shown in Fig 2, p. 16, will easily enable us to try. As there stated, a beam of pure sunlight, H *b*, dispersed by the prism P, will be spread out on the opposite wall into a superb sheaf of colours, ranging from violet through blue, green, yellow, and orange, to red. While this spectrum is glowing in all its glorious gradations of colour, let us cover the hole in the shutter H with our bit of red glass. What a marvellous transformation we behold! The red, and a good deal of the orange end of the spectrum, is still perceptible, but the more refrangible colours have apparently vanished, and darkness reigns in their stead. Nay, the experiment may be rendered yet more striking if we admit the sunlight through a horizontal slit at H, instead of a round hole, and cover half of this slit with our coloured glass. Then will two spectra be thrown side by side on the screen, and the extent to which the red glass has absorbed the colours above the yellow will be even more strikingly shown. It does not in reality *wholly* absorb even the blue rays, but it needs more refined apparatus than we are employing to show this satisfactorily. Blue glass has the curious property of chiefly cutting out the green, yellow, and orange parts of the spectrum, but of letting through quite a notable quantity of red. The bearing of this upon the ultimate constitution of light will be seen as we go on.

If it be here asked, What becomes of the light which is absorbed by the coloured glass? the answer is very simple. We have seen, over and over again in these papers, that light consists of a series of undulations—in other words, to adopt Tyndall's phraseology, that it is only "a mode of motion"; and what really happens is that these rapid vibrations are converted into slower ones (too slow in fact to affect the eye as light at all), which we recognise as *heat*, and which very slightly raise the temperature of the glass. We are now on the threshold of the explanation of the colours of ordinary natural objects. Take the geranium petal as an example. Looked at in sunlight this is of a vivid scarlet. Why? Simply because, as we have said, the substance of the petal absorbs all the more refrangible part of the spectrum (converting it into heat) and reflects the scarlet light which is left. And here we may revert to our dark-room and prismatic spectrum, Figs. 2 and 3, pp. 16 and 17, for the purpose of performing a most striking and instructive experiment. Let us take our geranium into this room, and passing it slowly up the spectrum, watch the succession of effects. It is needless to say that in the red it glows with an intense red light; but as it travels upwards this disappears until, when we arrive at the green, it is impossible to distinguish the petal from a piece of black velvet. Nor is the reason far to seek. The petal can only reflect red light. There is *no* red light in the green, hence it reflects none at all, and puts on the weird and unnatural black hue of which we have just spoken.

The colours exhibited by dress materials, woollen, silk, &c., have their origin in absorption. White light falls we will say upon a piece of merino. Some of it (not very much) is reflected from the upper surface as from a mirror in the form of white light, but the rest penetrates the fibres of the cloth and is partly returned to the surface coloured from the under part of the topmost bundle, so to speak, of fibres, and partly penetrates deeper into the material, only ultimately to emerge more highly coloured still. It is the combination of these different shades of colour reflected from different depths in one piece of merino, diluted by the white light directly sent back by its actual surface, which forms what we recognise as the colour of the cloth. Silk being much more reflective than wool, gives back a more intensely coloured, richer, and more lustrous light than does wool; while in velvet, the fibres are seen endways, so as to suppress superficial reflection altogether, and this enables the internal reflected light to reach the eye practically unmixed with white light, giving an effect of richness and depth of colour familiar to everybody. The colours of metallic surfaces are referable in like case to absorption, but in this case the light returned from the subjacent layers is considerably mixed with a flood of white light superficially reflected. The powerfully reflective nature of silver is known to all who will read these lines. Lambert has shown that while white paper only reflects 40 per cent. of the light which falls upon it, silver returns actually 92 per cent. of incident light. Water, albeit limpid and colourless if it is examined when in small quantity, shows a very distinctly blue tinge when regarded in any very large volume. The blue of the Lake of Geneva and the almost black colour of the Atlantic will arise to the minds of many of our readers as illustrations of this.

That absorption actually does take place in these cases is shown by the experiment (originally, we fancy, due to Bunsen) made by Tyndall, in his homeward voyage after the solar eclipse of 1870, and subsequently described by him at the Royal Institution, of sinking a weighted porcelain plate in the Atlantic Ocean, and noticing how it gradually appeared bluer and bluer as its distance from the surface increased. Naturally, when the bed of a shallow sea is sandy—and hence more or less yellow—the superficial water looks green from the combination of its own proper light-blue colour, due to absorption with the

light reflected from the bottom. It must be noted that the suspension of foreign bodies in water materially affects its colour, since certain vegetable matter converts the normal blue into a very greenish blue; and we have ourselves seen water brilliantly green, as in a dyer's vat, from the presence of enormous numbers of the *Euglena viridis*. Decaying organic matter tinges water brown, as may be well seen in some of the torrents in the rivers in North Wales; but these are all departures from what may be called the natural colour exhibited by water in great thickness, the blue of which we have already spoken. The green of green leaves presents some curious chromatic anomalies, inasmuch as, with a large proportion of green and yellow, it also contains a little blue and violet and a good deal of crimson! This has been determined by the aid of that instrument known as the spectroscope, a description of which is promised by the Editor of this journal in a forthcoming series of papers on "Light-sifting." Those especially interested in this branch of the subject, then, must, *pro tempore*, take our word for the results thus obtained until the time arrives for an account of the instrumental means by the aid of which they have been arrived at. We may, however, here once more reiterate in a succinct form what we have been endeavouring to explain in some detail, viz., that the colours of objects in the natural world, as we see them, have their origin in the selective action of those objects on white light, certain constituent vibrations of which are absorbed and converted into heat, while the remaining ones (mingled with more or less pure white light superficially reflected) impress the eye with the colour corresponding with their length.

Thus much for the ordinary production of colour. It remains to say something of its abnormal, unusual, or extraordinary production. Bearing in mind what we have previously said (p. 16) about colour, as such, existing only in the sensorium, it is not difficult to conceive that if we can contrive in any way to cause a similar excitation in that part of the brain concerned in the production of the sensation, we shall experience it, albeit we are in total darkness. Thus Helmholtz tells us that an electrical current passing through the forehead to the hand, causes a seemingly wild rush of colours, although no light whatever may be present. Every one, too, coming suddenly out of sunshine into a dimly-lighted church, and kneeling with his head in his hands, must be familiar with the brilliant spectra that pass before his closed eyes. Of complementary spectra we shall have something to say in a future paper. Even a black spiral on a white disc set in revolution in an apparatus to be hereafter described, will, if rotated at a proper speed, seem greenish, and when turned more quickly, reddish; while santonin, taken internally, causes everything white to appear greenish-yellow.

And this brings us to the very remarkable subject of colour-blindness, or total incapacity for seeing certain colours, with which many people are quite unwittingly afflicted. Dalton, the famous chemist, was thus affected. Red and green were absolutely undistinguishable by him; and as he was the first to give a scientific description of this strange infirmity, it is still commonly called Daltonism. So comparatively common is this particular defect that it has been calculated that between five and six per cent. of people in this country are more or less afflicted with it. We have ourselves known more than one person who could detect no difference whatever in the colour of the berries of a holly branch and its leaves, and only recognised them by their shape. Pole and Mivart, among other eminent men of science, are sufferers from this strange defect. The serious importance of its existence will be recognised when we consider how many thousands of people are daily employed on the railways of the United Kingdom, where the conventional signals indicating caution and danger are green and red respectively, the two very colours which more than a twentieth of the entire population are unable to distinguish one from another. Happily this has attracted serious attention everywhere, and we believe that some kind of colour-test is now applied to all signalmen, guards, engine-drivers, and others, whose failure to discriminate between these two colours may be fraught with the most frightful consequences. In 1876, Professor Holmgren found among 266 employés of the Upsala-Gefle Railway in Sweden that thirteen were colour-blind. The test ordinarily employed consists of a series of skeins of coloured wool, which the person under examination is required to match. Seebeck succeeded in making himself temporarily colour-blind by wearing ruby-red spectacles during the greater part of one day. When they were removed he could only discern two colours. A rarer form of colour-blindness exists in which the sufferer sees only (what he calls) red and blue—including yellow in the former designation. Finally, in some rarer cases still, patients have been found practically destitute of any sense of colour at all; in fact, who saw the whole face of nature in mere light and shade, like a mezzotint engraving, a condition of things which may be imitated by the familiar Christmas experiment of salting a spirit-lamp and using the flame thus charged with sodium vapour as the sole source of illumination of a room. How under such illumination all traces of colour vanish and the spectators' faces assume a cadaverous and ghastly hue, very many of our readers know. Something of the sort is seen with the light of the ordinary "snapdragon" of this season of the year; though the absence of salt from the burning brandy somewhat mars the effect. The physiological causes of colour-blindness are somewhat obscure. It probably has its origin in some actual defect in those parts of the retina which are particularly set in vibration by the red rays. This, however, is a question which we do not propose to pursue here. It is enough if we have conveyed an intelligible idea of the phenomenon itself.

THE SOCIAL WASPS.

By E. A. Butler.

OF the *Vespidæ*, or social wasps, we have seven British species, including the hornet, which is by far the largest and most easily recognisable. The discrimination of the other species is not by any means an easy matter, and needs a very close attention to minute details. But the hornet is at once distinguished both by its size and colour; its hues are brown and yellow, instead of black and yellow, as is the case with all the other species.

Before, however, we can properly understand the differences of the species, or the reasons for their invasion of our homes and their pilfering of our food, it will be needful to sketch the life-history of a *Vespa*. As the plan is nearly the same in all, we need not at present particularise species, but only premise that we choose a subterranean, as being more common than an arboreal, builder.

We begin with a fine old female, or queen, as she is called, whom the warmth of advancing spring has aroused from her long winter sleep. She is an ancient dame,

one of the few relics of a past generation. She is, too, a widow, having lost her spouse at the advent of the previous winter, because his constitution, like that of all his compeers, was unable to endure the rigour of the frosty season. His progeny are all posthumous, and even yet his widow is no more than an expectant mother. As she issues from her winter retreat, the responsibilities of life crowd thick upon her; she finds herself without a home, without a helper; and yet in a few short weeks she will be surrounded, in a commodious retreat, with hundreds, if not thousands, of her own species, she herself not only their mother, but also their queen.

She has no thought of returning to the old home which was the scene of her youth; that has long since been dismantled, and what with winter rains, and the invasion of earwigs, woodlice, and other such barbaric hordes, few traces of it now remain. So, like her mother before her, she has to undertake pioneer life, and to make a clearing for her future colony. Fortunate is she if she can find some hole—a deserted mouse-burrow, or other tiny cavern—ready to hand; much labour of excavating will thus be saved, and she may begin at once to form the nest. But should nature not thus favour her, she must herself set to work, and by repeated attacks upon the virgin soil with her powerful jaws, gradually hollow out a cavern to her mind.

She will then repair to some oaken fence, or row of palings, and with those same useful tools that she always carries with her, and that have just done such good service as excavators, she will snip off particles of wood, clinging to the fence all the while, gradually working her way along the paling, and leaving behind her a pale streak where the thin outer layer of weather-stained wood has been removed. With a bundle of woody-fibres thus collected she flies away home, and working them up into a pulp with a secretion from her own mouth, plasters them out into a greyish material that looks something like crumpled tissue-paper. This is first formed into a kind of stalk, attached at one point to the roof of her cavern—for, unlike most builders, she does not lay her foundations below, but builds from above downwards. At the extremity of this pedicel, three shallow, cup-shaped cells are formed of the same material, and placed vertically, and with mouth downwards; then a number of layers of the same papery substance are arranged above the cells, so as to form a dome-shaped roof.

Now there can be a commencement of egg-laying: each cell is furnished with one egg, which is glued to its side. The egg soon hatches, and the footless grub that issues from it is said at first to maintain its position in the inverted cell, and prevent itself from falling out of its bed, by a sticky secretion from its own body. The first batch of eggs produce workers, and it is essential for the queen to get them through their metamorphoses as speedily as possible, that she may have assistants to relieve her of some portion of her multifarious duties, which would soon become too onerous for her.

She has now to collect food for the hungry grubs, which cannot provide for themselves, and are entirely dependent on what she brings them. Sailing forth, she will soon seize a luckless fly or other small insect, whose corpse will be carried home, and doled out to the nestlings as they are able to receive it, their mother having made a previous mastication of the morsels. They open their little jaws, each armed with three teeth, and the mother puts the food into their mouths much as a bird would feed her callow brood. Fed several times a day, and fattening on such food, the ugly grubs increase rapidly in size, while the mother enlarges their cells as necessity requires, making them hexagonal in their upper part, and raising their walls by the addition of layer upon layer of her building material, till the grubs are ready to slip out of their larval skin and enter pupahood, when her constructive exertions cease, and the larvæ have now to look after themselves.

Each first spins a convex cap of silk, covering the open end of the cell, and then, in the seclusion of this snug retreat, shielded from the curious gaze of inquisitive neighbours, the incipient wasp is "unclothed" and "clothed upon." Not many days elapse before the final change occurs, and, in something under a month from the laying of the egg, the perfect insect is ready to join its mother in her exertions for the enlargement of the home—or rather to relieve her of them. So batch after batch of workers is produced, and each, as it arrives at maturity, takes its share in the duties of nest-enlargement and feeding the young.

When one tier of cells has reached its appointed limits, another is commenced beneath and parallel to it, and connected with the former by sundry tiny pillars of the same *papier mâché*. We note here, therefore, three differences between a wasp's comb and that of bees, viz.: 1st, the combs are made of paper instead of wax; 2nd, they are placed horizontally instead of vertically; and 3rd, the cells are formed only on one side of the comb (the lower), instead of both. The number of insects produced cannot be accurately estimated from the number of cells, because several inmates often successively occupy each. It is manifest, therefore, that the population of the nest, including insects in all stages, is always in excess of the number of cells.

It is not till quite late in the season that the males and females are produced. They are both larger than the workers, and therefore occupy in their preliminary stages cells of larger dimensions than those mentioned above, and those of the females are placed in a part of the nest more or less separate from the rest. The males, of course, have no stings, since this organ is but a modified ovipositor, but both females and workers are provided with them. The males, therefore, may be handled with impunity, and if only one could readily recognise the sex, there would be no hesitation in handling them. When all three sexes are seen side by side, there is little difficulty in separating the males, as their antennæ are longer than those of either of the others; but as this is a comparative character, it is not so easy of application when only a single sex is seen. To some people, no doubt, a stingless wasp may seem altogether incredible, and, perhaps, contrary to experience; but it must be remembered that the majority of the specimens people in general meet with are workers, which regale themselves on our dainties, not for their own delectation only, but chiefly to minister to the wants of the grubs which are their care. The males live only for a short time at the close of the season, and, as they have not the important foraging duties of the workers to perform, they are not so likely to force themselves on our notice.

Wasps are easily affected by changes of temperature: as with most insects, cold has a benumbing influence on them, and consequently the first frosts of autumn begin to tell upon their numbers, and before long the whole population perishes with the exception of a few of the females, who manage, in the shelter of some retired spot, such as in moss or under bark, to survive the winter, and upon these hibernated specimens depends entirely the perpetuation of the species from season to season. Since, therefore, they are so dependent on climatic conditions,

it is not surprising that their numbers are very different in different seasons; in some years, as was the case in 1878 and 1880, they are so numerous as to be a positive plague, and in others comparatively few are seen.

In country places, wasps' nests are not unfrequently found in thatched roofs or under the eaves of houses, as well as attached to beams in lofts, barns, and out-houses. Even the ground-wasps sometimes select such situations, and the hornet, too, occasionally establishes itself in a loft or barn. Sometimes amongst thatch are found numbers of the rudimentary nests constructed by the queens only, which have never advanced beyond their primitive condition, having been, for some reason or other, abandoned shortly after their construction.

The insects themselves are quite omnivorous in their tastes; one might almost say, "Whatever man can eat, that wasps can eat"; the swarms that, in a hot summer, crowd the windows of country grocers' and bakers' shops are a pretty good proof of this. Sweets of all kinds, including ripe fruits, are very attractive to them; but cakes and bread, or even meat, will also be readily devoured. Living insects, too, they catch in great numbers, especially flies, and it has been well remarked that, while they will at one moment be robbing the butcher by devouring his meat, they will at the next be making valuable restitution by devouring the flies that would lay their eggs upon it; and it is probable that the advantage that accrues to us through their destruction of so many disagreeable insects is more than sufficient to counterbalance any loss we may sustain through their attacks upon our fruit and other stores. In catching their insect prey they are very dexterous. Professor Westwood says, "I have watched the common wasp hovering over and darting hawk-like upon flies upon excrement, careful not to soil its own legs and wings." So, too, they will pick flies off the backs of pigs in their styes. They are clever, too, in chasing and dodging insects to catch them on the wing. When the prey is caught, the wings, head, and legs, being more or less hard and dry morsels, are bitten off, and the rest of the body devoured. Flies, butterflies, and even bees are treated in this way. Unlike the *Odyneri*, they do not use their stings in giving a quietus to their prey; the action of their powerful jaws is quite sufficient, without the aid of the more deadly weapon.

They are most industrious in the obtaining of supplies, and well they may be, considering the number of hungry mouths they have so constantly to fill; greedy grubs, ever on the look-out for something good, demand all the energies of even the large staff of workers that are in continual attendance upon them. Sir John Lubbock records a case of one of his wasps, which paid no less than ninety-four visits to a store of honey in one day. And in the performance of these duties they are not only industrious, but wonderfully persistent, and undaunted by obstacles or dangers. The same diligent observer records several instances in point. One wasp had smeared its wings with the syrup on which it was being fed, and so rendered itself incapable of flight; Sir John, therefore, put it in a bottle of water, and gave it a bath, transferring it then to a dry bottle placed in the sun, as the best means of getting it dry. When quite recovered, it was allowed to go free, and after thirteen minutes it returned to the syrup-saucer that had been the scene of its former disaster, and began to sip the liquid with as much avidity as before, evidently quite undeterred by its sad experience. Another was immersed in water till quite insensible, in other words, virtually drowned; on being taken out, it recovered after a while, and at once set to work again at the business of its life, as though there had been no interruption.

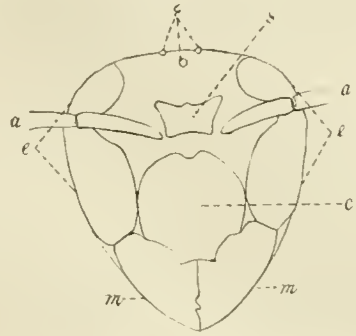


Fig. 1.—Head of Wasp: *a*, antennæ; *c*, clypeus; *e*, compound eyes: *m*, mandibles; *o*, ocelli; *s*, coronet spot.

The head of a wasp (Fig. 1) is a remarkable structure, and well worthy of a close and attentive examination, if only to see what a variety of adornment is lavished on even minute and otherwise obscure parts of the insect, and to marvel at the number of organs that can be collected into so small a space. The entomologist who wishes to distinguish the different species from one another must pay great attention to the minutiæ of this part of the insect, because some of the best distinguishing marks are to be found here. In shape the head is something like a triangular cake with the angles rounded off; it is set on the body vertically, with the base of the triangle placed horizontally, and forming the crown. In front it is slightly convex and behind concave, and it is attached to the thorax only by a small junction in the centre of the hinder surface.

The apex of the inverted triangle is formed by the meeting of the two exceedingly stout and broad jaws, or mandibles, each furnished on its cutting edge with an inner and an outer row of notches or teeth, separated by a groove. They move laterally, and are in most cases attached by a sort of hinge-joint just below the compound eyes. The jaws themselves are yellow, but the teeth black. Occupying the centre of the head, just above the jaws, is an important and conspicuous organ called the clypeus. It is slightly projecting, and is like a broad plate with an outline which is curved above and angular below. This, too, is bright yellow, but it carries certain black marks upon it which vary in the different species, but are in most cases sufficiently constant in the same to be used as diagnostic characters.

Just above the clypeus the two antennæ are inserted, not very far apart from each other, in the centre of the head. Each consists of a long basal joint, the scape, and a stout, many-jointed terminal part, the flagellum. Between the antennæ, and stretching from the base of one to that of the other, is a remarkable, bright yellow spot of most elegant shape. It usually bears some resemblance to a sort of coronet, and situated as it is, just above the equally brilliant yellow clypeus, it suggests, in conjunction with the latter, the idea of a nobleman's coat-of-arms surmounted by his coronet, as though the wasp were carrying the evidence of its rank and identity on its brow; and it is not a little remarkable that in this coat-of-arms, so to speak—viz., the combined clypeus and coronet—we really do find some of the best distinguishing marks of the species.

The sides of the head are occupied by the compound eyes, which, being situated just on the bend, of course command the most extensive horizon possible. They are reniform, or kidney-shaped, there being a deep indenta-

tion in their inner outline at that point which is just behind the antennæ when they are in their most natural position; and it would almost seem as though this limitation to the extent of the visual organs were in some way or other connected with the presence, immediately in front of the spot, of the great black antennal scape, which would certainly render useless for direct vision any eyes situated immediately behind it. Yellow streaks bound more or less of the outline of the eyes, and greatly improve the appearance.

On the top of the head we see three small, polished, glassy-looking knobs, frequently of a ruby or yellow colour, and arranged in triangular form. These are the ocelli, or simple eyes, and their number and arrangement are both very characteristic of the order Hymenoptera; we find the same little organs in bees, appearing like tiny sparkling gems, half hidden by the hairs amongst which they are imbedded. In the Ichneumon Flies, Saw-flies, &c., we find a similar arrangement.

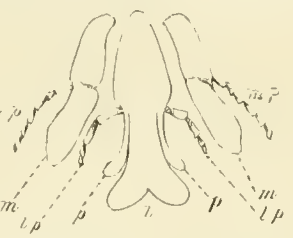


Fig. 2.—Labium and maxillæ of Wasp: *l*, labium; *m*, maxillæ; *lp*, labial palpi; *mp*, maxillary palpi; *p*, paraglossæ.

These are all the parts that are visible from above in the natural position of the organs; to get at the rest of the complex apparatus of the head we must open the jaws, and then underneath we are introduced to a bewildering collection of organs (Fig. 2), as puzzling at first sight as a piece of modern machinery. But a little turning and twisting about, and examination from various points of view, soon enables us to make out the general plan and to see the relation of the parts to one another.

First, and just underneath the position occupied by the mandibles when closed, are two thin, blade-like pieces beset with hairs pointing forwards. These are the terminal portions of the maxillæ, or secondary jaws, which, as well as the mandibles, are capable of lateral movement. Tracing them back to their point of attachment to the head, we find that the basal part is of a somewhat more substantial character than the terminal, and that at the junction of the two parts, on the outer margin, each maxilla carries a slender six-jointed appendage, the maxillary palpus. When the maxillæ are moved aside, a single central organ, previously partly covered by them, comes into view; in its front part it is thin, flat, and band-like, but behind it is much thicker. This is the labium, or so-called tongue. The flat portion is rather deeply bifid in front, and carries two narrow organs, the paraglossæ, attached to its sides, but not quite reaching the tip; thus the free edge of the labium presents four rounded divisions. Further back it carries two jointed appendages, the labial palpi; they are stouter than those of the maxillæ, and are only four-jointed. It is this tongue that the insect uses as a trowel in its plastering operations, when it is manufacturing its nest. When the mandibles are closed, they almost entirely conceal all this mechanism, only the tips of the palpi being visible.

From the above description it will be evident that a wasp's head is not quite so simple an object as it might at first sight appear; nevertheless, there is no great difficulty in making out for oneself all the above points. Only two tools are necessary, a needle to open out the mouth organs, and a hand-lens to examine the different parts. The examination is best conducted on an amputated head. The junction between head and thorax is so slight that there is no difficulty in decapitating a wasp (a dead one, of course!), and if a stout pin or the end of a match cut down to a point be inserted in the small hole that will be found at the spot where decapitation took place, and the head be thus impaled after the fashion in which the authorities in this country once upon a time delighted to treat the heads of political offenders who had suffered death for their indiscretion, the head may be more conveniently handled and placed in any desired position for examination.

We must defer the consideration of the different species of wasps till the next paper.

MOVEMENTS OF THE PLANETS.

By Richard A. Proctor.

THIS month I give the movements of the four inferior planets, Mercury, Venus, the Earth, and Mars, leaving to a later opportunity such explanatory diagrams as may seem required to represent the motions of Mars with regard to the earth. I give also a map (taken from my zodiacal series, showing the path of Mars during the opposition of 1886, or really from November, 1885, to July, 1886). Each diagram explains itself.

The following alterations should be made in the chart of the solar system facing p. 8; (in the second edition of our first monthly part, the chart was I believe corrected):—Change 1889, outside the orbit of Neptune into 1885, and *vice versâ*; 1886 into 1888, and *vice versâ*. In other words, date the five points on the orbit of Neptune from Jan. 1, 1885, to Jan. 1, 1889, the reverse way. Alter Jan. 21 outside the orbit of the earth, to June 21. With black ink hide the vertical straight line caused by a split in the block. Note that the numbers round the orbits indicate thousands of days from the supposed starting-point in longitude 180°.

MUSIC.

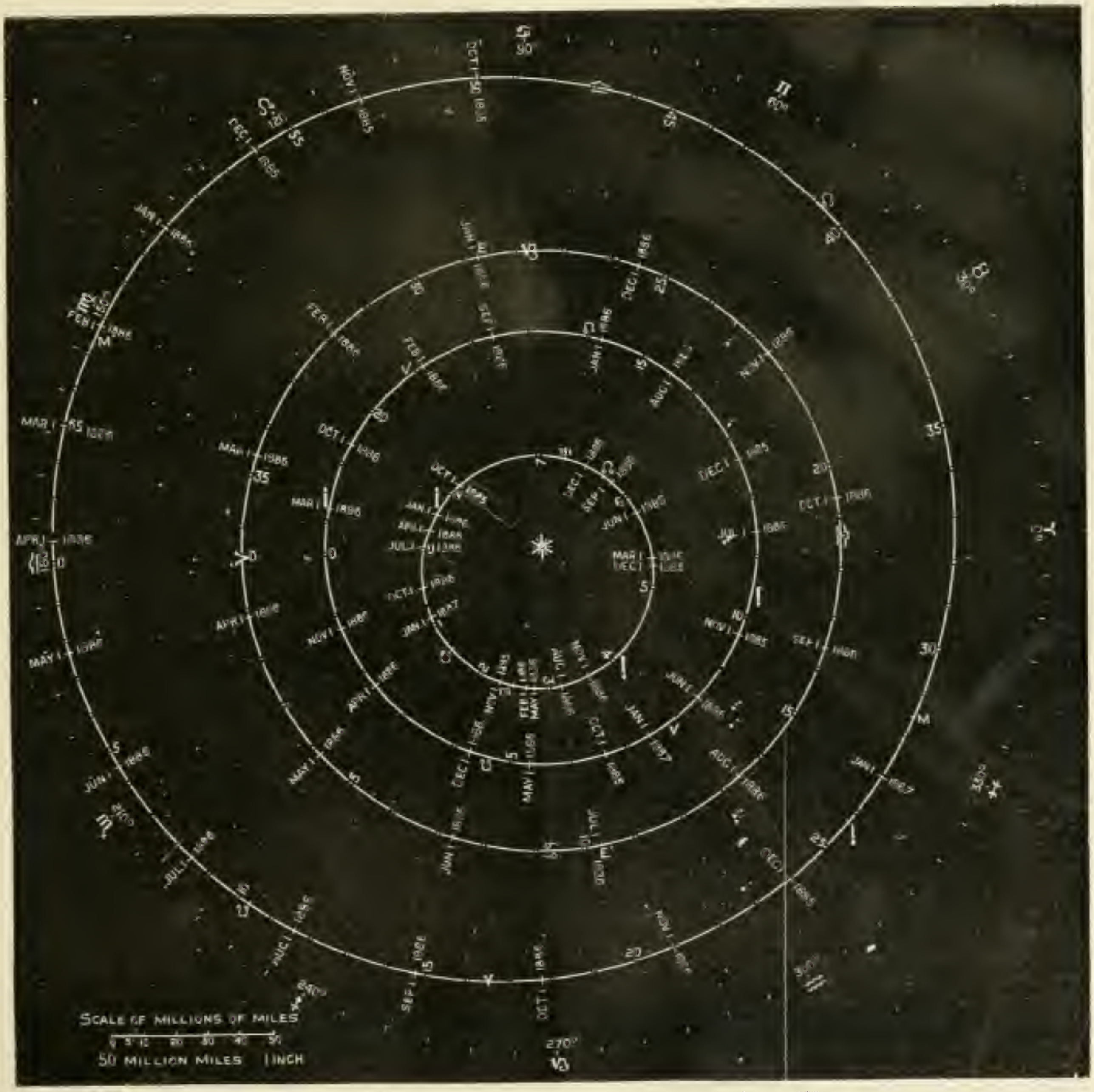
By Baroness Von Gottrau.

Introduction.

IT is not, I believe, the object of this magazine to publish the history of any particular subject, therefore it is not my intention to give in these articles a record of dates of when certain composers lived, what they composed, when certain musical instruments were invented, &c. But I would like to write about the old musicians and composers, also the composers and musicians of our time, and, in fact, about the study of music in general.

I have met persons who thought of music *only* as a combination of different tones or sounds, and would be pleased to listen to a certain piece of music, because at the moment those particular tones seemed to suit their disposition; but they would give not a thought to the meaning of the music, for to them it was simply a combination of sounds — meaning nothing in particular. But what is Music? It is indeed

Path of Mars during the Opposition of 1886.



Movements of the Terrestrial Planets from Oct. 1, 1885, to Jan. 1, 1887.

the art of combining and arranging tones; and in and through those tones we have the expressions of all ideas and feelings of love, joy, sorrow, beauty, grandeur, nobleness, holiness, respect, and delicacy. The old Greeks classed,—under the head of music the poetry, philosophy, astronomy, and all arts over which the Muses presided; and as far back almost as we have any evidence at all of men, have they given expression to their feelings by different tones of the voice, feelings of gladness and wonder naturally being expressed in higher tones, and depression or sorrow in lower tones. In song, then, was the beginning of the art of tones; and as men have always given expression to their feelings and ideas in this way, have we not then to a great extent in music the history of peoples? In books, of course, we find the minute history of nations, and we learn from them about dates, facts, and character; in a picture the artist can actually put before our eyes only one certain moment of an act, or one degree of an idea or feeling—though certainly they may *suggest* much more to us; and in architecture we can see the progress of man both practically and artistically. But in music we are made to feel with the people at every moment and in every degree; for the composer plants the seed, as it were, and then, through the wonderful harmony and still more wonderful modulation of the tones of expression, we are carried along with him in the progress and growth of this seed, until at last the whole opens ripe and full to us.

But, of course, not every one can at once understand and appreciate a master-composition, no more than every one can at once understand and appreciate a master-picture. All art, to be properly appreciated, must be studied; thought must be given to it. If a person who had never seen many good pictures, nor given much thought to the art of drawing and painting, should suddenly be placed before a master-picture, he could not at once see and appreciate the fine points of the picture, though the whole would seem pleasing, and probably very interesting to him; but a student in this art would at once notice every detail—every feature of the face, every branch of the tree, every light and shade, and if all be properly executed. In this same way do some persons hear a musical composition; it sounds pleasant to them, but to a student every degree of modulation, every chord, and, in fact, each tone, contains some particular meaning and expression.

For example, a lady, a friend of mine, who has talent for interpreting some music very nicely indeed, after playing one of Beethoven's piano compositions for her father, asked him how he liked it. "Oh," replied he, "that is tolerably nice." But after his daughter had explained the meaning of those tones, how the soft, sweet, melodious murmur in the beginning was a declaration of tender love, then as answers of rejection came the lover became agitated, and after awhile, as his disappointment became great, the sounds modulated into deep despair, until at last he grew so hopeless that the music sounds as though he would run away from himself,—then the old gentleman would ask, "Please play for me that love-story; it is beautiful and interesting."

But if that piece were played by some one who could not properly understand and feel it, and in the beginning those soft, sweet, smooth, and passionate tones were played coldly and abruptly, and those agitated chords interpreted more as vexation, and the end played like some one doing a hop, skip, and a jump, for fun—how different would the music sound! In the same manner as this love-story is told to us, so have we religion, science, heroism, and every refinement of feeling. In the music of different countries we have told us the character of the different people. The Italian, German, French, Hungarian, Norwegian—in fact the music of every separate nation, even down to the peculiar sway of the songs of the negroes of the United States—how perfectly distinct is each music, and how, in hearing the melodies and harmonies of each people, we seem at the moment to be placed amidst them and to enter their life and feel with them.

What a grand and wonderful art is Music! How beautiful and interesting the relation of tone to tone, and how grand can the modulation from one key into another be made!

We live in a wonderfully musical age, if we think of the time when it was not known that the sounds of the different intervals could be put together and make harmony; or that by lowering one half-tone the third interval of any common chord we could change the expression from playfulness or gladness to weirdness or solemnity. How wonderful the change from that time to a time which has given us the compositions of the great Richard Wagner, where every degree of sentiment and feeling have been so truly represented, and the whole brought to such a magnificently perfect *ensemble!* But it is not time yet to talk of Wagner, of whom there is so much to be said that we shall have to devote to him at least the whole of one article.

As we are to talk about music in general, it will be well in this, the first article, to give a few hints in regard to the teaching of children. Mr. Ruskin says that every one can learn to draw, although not every one can become an artist in painting or drawing: and so I think every one can learn music—at least, learn to sing or play some musical instrument,—though every one cannot become an artist in music. And as Mr. Ruskin says about drawing, so in music has there been a great deal of bad teaching. Nearly all parents wish their children to learn music, as it is a popular accomplishment for every one to possess; but if the teaching of children would always be begun in the proper manner, we would hear a great deal more good music every day than we do.

In the first place the child should be taught to have the correct position of hands and wrists, for if one begins to play with the fingers flat on the keys, is it not a matter of course when they come to play more difficult and rapid passages the fingers cannot possibly pass over the keys or strings either so smoothly or rapidly as is often required? and is it not plain that one cannot play as lightly and delicately with the flat of the fingers as with the tips?

Then very often beginners are inclined to stiffen the muscles of the wrist in trying to make the tones stronger, but this only makes the music sound as stiff as the wrists are held; for it is impossible to make full, round, and flowing tones with a stiffened wrist. It is just as easy to keep the wrist loose and comfortable, and put the strength down in the ends of the fingers. Anything that is stiff cannot be flowing; and one of the great beauties and charms of music is in that flow, or, as it were, the loving attachment of one tone to another. These two faults in players are very easily corrected and explained, and if every one would be carefully taught this correct and easy position of hands and wrists, they would make much quicker progress, and would give more pleasure with their music both to themselves and to others. To most children it seems a tedious task to play *c*, *d*, *e*, *f*, *g* with the five fingers over and over, or *f* sharp, *a*, and *b* with first, third, and fourth fingers repeatedly; but if it be properly explained why

these exercises should be made, it would be easier and pleasanter for them. Every one with any delicacy of feeling likes to hear sweet sounds; then explain to each child how sweetly and still decidedly each tone should be touched, and how smoothly and lovingly they should be connected, instead of jerking the finger off each key or string as if it were glad to have finished with that note.

It is necessary for every one to practise some finger exercises in order to make the fingers more flexible, and if they are explained in this manner the child will love to try to make sweet, smooth tones, and make them embrace each other as if they loved each other, for certainly it is the proper way.

But children should not be kept too long upon finger exercises, for then, of course, it would become monotonous to them. I believe there is no one that would like to listen even to a pretty melody over and over again, day after day.

There is a law of repetition in music as in drawing and painting, and to a student of art there is something solemn in repetition; but we will talk of that later, for the repetition of musical exercises is indeed not an example of that interesting and artistic repetition.

Very much of any one thing is not good for a child, as it would become monotonous, no matter what it might be; so their exercises, after being explained in the proper manner, should often be relieved by little melodies, and these, of course, should be very minutely explained, and taught, above all else, to be played with a loving touch. And then, as the child progresses, the beauties of harmony, the artistic modulations, and the correct *ensemble* of every piece should be pointed out to it, so that after awhile, when it comes to study and hear more complicated compositions, it will more easily understand and appreciate them.

Children wonder why they should be troubled with having to put certain fingers here and there; then carefully explain to them why it is necessary to do so, in order to give smoothness and rhythm to the tones, and try to have them feel how beautiful it is to have one round, full tone glide lovingly on to another of like beauty.

Exactly the same rules may be applied to singing, only then the stiffness and jerkiness will be found in the throat.

And now, as we have the child started out with the right foundation, we will in time see how interesting the study becomes as it goes on from finger exercises and simple melodies up to the wonderful fugues of Bach, symphonies of Beethoven, and operas of Wagner.

A series of articles on drawing and painting will be carried on alternately with these on music, and the relation and similarity of these two arts will be interestingly apparent.

München, Nov. 18.

Mr. William A. Eddy, of the American Signal Service Bureau, calls attention to the fact that the study of the phenomena of tornadoes has advanced so far that predictions of the appearance of these terrible, destructive agencies can be made with a considerable degree of accuracy. Of thirty-eight predictions that tornadoes would occur in April and June of last year, eighteen were verified; of nineteen predictions in June and July of this year, fifteen were generally verified; and where regular tornadoes failed to arrive, violent wind and hail storms partially fulfilled the prophecy. Mr. Eddy thinks that a system of tornado signals should be established at every telegraph station in the tornado States. If the Government will do this much, at least some of the terrible loss of life and property due to tornadoes can be averted. The facts presented by Mr. Eddy fully warrant the small appropriation by Congress which will be necessary to establish such a system of signals.

INDIAN MYTHS.

By Stella Occidens.

AN Ottawa myth gives an amusing account of Onaiazo, the Sky-walker. It tells us that many years ago there dwelt an old Ojibwa and his wife on the shores of Lake Huron. They belonged to the beaver family, and they had an only son called O-no-wut-a-qut-o, or he that catches the clouds. They hoped to make a great man of him, and when he was old enough they gave him charcoal with which to blacken his face, instead of letting him eat any breakfast. This is the way he should have observed the We-koon-de-win, or fast, but he did not seem to like the idea. When his mother would not give him anything to eat, he stole birds' eggs, and ate anything he could find. One day his mother found him eating the heads of some fish which had been thrown away, whereat she was very angry, and took the food from him. In its place she gave him coals, and he was so indignant that he would not longer stay at home.

During the night O-no-wut-a-qut-o had a wonderful dream. A beautiful woman came down to him from the clouds. She told him that she had come for him, and that he must follow her. He did so, and soon he found himself floating in the air, higher and higher, till at last he reached the cloud regions. There he found himself in a beautiful garden, and near at hand a splendid mansion. When he entered, he saw spears, clubs, arrows, and other warlike instruments, tipped with silver, on one side of the hall; and on the other side there were things belonging to his fair guide, among them a frame on which she had been weaving a broad, rich belt of various colours (this is, no doubt, intended to represent the rainbow).

Presently she heard her brother coming, and she hid the stranger away. The brother came in. He was richly dressed, with silver all over him, which glistened brightly. After he had had a quiet smoke, he rebuked his sister, saying, "Nemissa, when will you quit these practices? Do you forget that the greatest of Spirits has commanded that you should not take the child away from below? Perhaps you suppose that you have concealed O-no-wut-a-qut-o, but do I not know of his coming? If you would not offend me, send him back immediately." His words were of no avail, so he called the lad, and said to him, "Walk about and amuse yourself. You will grow hungry if you remain there." He then gave him a bow and arrows and a pipe of red stone, as a token of consent to his marriage with his sister.

O-no-wut-a-qut-o enjoyed his new life exceedingly, and wandered all day long through the flowery plains and green valleys, watching the birds with their gay plumage. These were more beautiful than the birds he had seen on earth. One thing he thought very strange. He noticed that every morning the brother (the Sun) disappeared, and did not return till the evening, and during part of the night the sister (the Moon) was absent. One day he went with the brother on one of his daily trips. He had some strange experiences. About midday he became very hungry, and he asked his guide if he could not have something to eat. "Patience, brother," we shall soon reach the spot where I eat my dinner, and you will then see how I am provided." After a while they reached the place, and here O-no-wut-a-qut-o seeing a hole in the sky, peeped through. He saw villages, lakes, fighting, feasting, and dancing, and some young men, on a green plain, playing a game at ball.

"Do you see," said the brother, "that group of children

playing beside a lodge? Observe that beautiful and active boy," said he, at the same time darting something at him from his hand. Immediately the child fell, and was carried to the lodge amid wailing and lamentation. The she-she-gwun of the meeta sang a song in behalf of the child, asking that its life might be spared. "Send me up a white dog," answered the companion of O-no-wut-a-qut-o, and a white dog was killed and roasted. Part of it was divided among the people, and part of the roasted animal was sent up to the sky by the master of the feast, who said, "We send this to thee, great Manito." After the two wanderers had eaten their dinner, they returned to the lodge by another path.

Soon, O-no-wut-a-qut-o became tired of this easy life, and longed to return to the friends he had left behind. With much reluctance his wife allowed him to return, saying, "Since you are better pleased with the cares and the ills and the poverty of the world, than with the peaceful delights of the sky, and its boundless prairies, go! I give you permission, and since I have brought you hither, I will conduct you back; but, remember, you are still my husband. I hold a chain in my hand, by which I can draw you back whenever I will. My power over you is not in any way diminished. Beware, therefore, how you venture to take a wife among the people below. Should you ever do so, you shall feel the force of my displeasure."

As she said this, her eyes sparkled, she raised herself on her toes, and stretched herself up with a majestic air; and at this moment, O-no-wut-a-qut-o awoke from his dream. He did not heed the words of his spouse, and married a beautiful young woman, who died four days after. He married again, but this time he disappeared, and it is supposed that his sun-wife had called him back to her home in the clouds.*

There are many quaint Indian stories about the moon, who was supposed to be the Goddess of Night, Water, Darkness, Rest, Death, and sometimes of Sleep. Among the Hurons the word for the moon is derived from the word for water, and in Aztec theology the words for moon and water are often confused. In the same way the words for sun and fire are alike in some of the American languages. In Peru the festival of the God of Water was held at full moon, and in Mexico the crops were regulated by its different phases.

The Brazilian mother carefully guards her child from the moonlight, believing that the rays of the moon will produce sickness.† The moon is supposed to produce dampness, which causes so much sickness and death; it throws parts of the earth into deep shadow, wherein may lurk a hidden foe; and the cold light of the moon is regarded as in opposition to the warming rays of the sun, which bring brightness and comfort to all on earth. We can understand, then, that to the wild Indian the moon should be as an evil spirit, all its effects being regarded as harmful. She is supposed to send dreams both good and bad, and can please or torment at pleasure. Of this the story of O-no-wut-a-qut-o is an instance, the moon herself taking part in the dream.

The Algonquins believe that the moon is a female spirit, wife of the great Manito, whose heart is the sun; whilst the Ojibwas believe that she is the sister of the sun. The Algonquins believe that the moon brought death and disease on earth, and she is supposed to kill men, making them die a wretched death.‡

* Schoolcraft "Hiawatha Legends," p. 228.

† Brinton's "Myths of the New World," p. 140.

‡ In Egypt it was supposed that Isis, the goddess of moisture (Isis being also the name of the moon), caused all sickness, and sacrifices were offered to her in propitiation.

The Aztecs believe that when the sun first disappeared in the west, and the whole earth was left in darkness, a victim had to be offered up for his return. A leper was chosen, named Nanahuatl, and he was burnt on the funeral pyre. Metzli followed his example, and as she disappeared in the flames the sun rose in the east. Metzli is, no doubt, the aurora or morning light, in whose glory, as it gilds the east, the moon wanes.

It was supposed that dogs were in some way related to the moon, because they were observed to bay at her. The practice has cost them some pains and penalties.* It is the custom among many races, such as the Peruvians, Tupis, Creeks, Iroquois, Algonquins, and the Eskimos, to beat dogs during an eclipse.† These races imagine that the eclipse is caused by a great sun-swallowing dog, and they imagine that he will stop on hearing the howls and cries of the dogs on earth. This sun-swallowing dog is the Goddess of Night, who tries to darken the world during the day. "The ancient Romans sacrificed dogs to Hecate and Diana; in Egypt they were sacred to Isis. Thus as traditionally connected with night and its terrors, the Prince of Darkness, in the superstition of the Middle Ages, preferably appeared under the form of a cur, as that famous dog which accompanied Cornelius Agrippa, or that which grew to such enormous size behind the stove of Dr. Faustus."

The dog is supposed by the Shoshones to be their ancestor, and the Nahuas hold the animal in such high honour that it has a temple of its own, a congregation of priests devoted to its service, statues carved in stone, and an elaborate tomb at death. The dog is said to be represented by the god Chantico, whose audacity caused the destruction of the world. In fact, we see that the dog holds a very important position in the legendary lore and superstitions of the Indians.

It is natural that eclipses should cause much wonder and surmise among the savages of America. Even in European countries the custom still exists of making a great noise and beating kettles and drums during an eclipse. The idea is, as among the Hurons, that the moon is sick, and that the noise will help her to recover.

As the North Americans imagine that the eclipsed sun is swallowed by a great dog, so the Chiquitos of South America believe that the eclipsed moon has been hunted by wild dogs, "who have caught and torn her till her light is reddened and dimmed by the blood flowing from her wounds. So they raise frightful howls and lamentations, shoot arrows into the sky, and seek in every way to drive the monsters off." ‡

The Caribs imagine that the sun and moon are being devoured by Maboya, the hater of light, whilst in the Tupi language a solar eclipse is described by the words, "Jaguar has eaten sun," and the tribes send burning arrows to drive the beast away from his prey.

It is strange that so little reference is made in Indian folk-lore to the comet, which is of all heavenly bodies the most awe-inspiring. Longfellow refers to Ishkoodah, the comet, in "Hiawatha," two or three times, but merely says:—

> Many things Nokomis taught him
> Of the stars that shine in heaven;
> Showed him Ishkoodah, the comet,
> Ishkoodah, with fiery tresses.

And again he says:—

> He, the Master of Life, descending,
>
> . . . .
>
> Gleamed like Ishkoodah, the comet.

* Brinton's "Myths of the New World," p. 143.

† "American Antiquities," p. 333 (Bradford's).

‡ Tylor's "Primitive Culture," Vol. I., p. 329.

There is, among the Algonquin myths, a story resembling in places the tale of Cinderella:—

There once dwelt in a lodge in an Indian village a beautiful being who was always invisible, and his only companion was his sister. If any girl could see him, it would be her privilege to marry him, and the girls, being aware of this, were very fond of visiting the sister, and walking with her beside the lake in the evening. They would often pretend to see the invisible one, but the sister would ask them questions about him which they were unable to answer correctly. They would then return to the lodge together, and eat supper, and all that could be seen of the brother would be his mocassins as he took them off.

This was aggravating. At last two sisters determined to try their luck. They left their third sister to mind the house, and sought the lodge arrayed in all their finery. Here they were welcomed by the sister, who, however, saw through their designs, and was prepared for them. They took the usual walk by the lake, and when the sister asked them if they could see her brother, they declared that they did. She asked them, "What is his moose-runner's haul?" or, "With what does he draw his sled?" and she knew by their replies that they were not telling the truth. She then said, "Very well; let us return to the wigwam." The sisters, however, did not see her brother, and were very angry.

Now their younger sister wished to try her luck, but her face and hands were badly scarred where her sisters had burnt her with hot coals. However, she made herself look as nice as possible, and although her sisters jeered and laughed at her she went on her way. As soon as the sister saw her, she received her kindly, for she knew that the girl had been ill-treated. Walking by the lake, the despised girl saw the brother, and when the sister asked her, "What is his sled-string?" "It is the Rainbow," she answered. "And what is his bow-string?" "His bow-string is *Ketaksoowowcht*" (the Spirit's Road, the Milky Way).

The sister knew by her replies that she had seen him, and taking her home, bathed and dressed her. Her face became radiant with beauty, her hair, which had been burnt off, fell around her in long tresses, and her eyes shone like stars. When the brother came home, he admired her beauty, and seeing that she was dressed as a bride, he smiled and said, "*Wajoolkoos!*" (So we are found out!) "Alajulaa" (Yes), was the sister's reply; and the girl became his wife.*

MR. HERBERT SPENCER ON PRIESTHOODS.†

By Richard A. Proctor.

IN the last number of Knowledge I gave a brief abstract of Mr. Spencer's discussion, in the book before me, of the relations between Church and State. I propose now to consider more generally his discussion of "Ecclesiastical Institutions."

It is hardly necessary to point out that the great value of this work, as of the whole series of works by the great philosopher of our age, resides in the application of the principles of evolution to the subject of discussion. It would be an injustice to Mr. Spencer to say that in regard to the general doctrine of evolution, he is as Francis Bacon where Darwin is as Newton. For Bacon was in many respects but an inexact student of science, and in regard to Newton's special department not only held, but maintained, altogether erroneous ideas, whereas Spencer in every department of science required for his studies has obtained that true general view which is all that his general survey needed or would permit, while in some, and in particular in Darwin's special department, he has been among the foremost leaders in exact inquiry.* Nine-tenths of the subject-matter which my friend Mr. Clodd proposes for example to deal with, belongs to the domain surveyed by Mr. Spencer, where one-tenth only which belongs to the region surveyed and cleared by Charles Darwin.

In the volume on "Ecclesiastical Institutions," Mr. Spencer has completed the sixth part of the "Principles of Sociology," the parts which remain to be included in the second volume of that great work being those relating to "Professional Institutions" and "Industrial Institutions." We read with much sorrow Mr. Spencer's expression of anxiety lest the completion of these remaining sections should be delayed, or even prevented, by such ill-health as has delayed the appearance of the present volume—which follows the fifth division, on "Political Institutions," after the long interval of three years and a half.

Rightly to understand the evolution of Ecclesiastical Institutions we must recognise the origin and understand the development of the religious idea in man. Is this idea, and especially the thought of deity, innate? This is commonly assumed; but all the evidence is against it. If the deaf and dumb, instructed at mature age, told us that they had always had the idea of a Creator of the world, that of itself would not prove the idea to be innate, because it might well have been derived through inheritance: but as a matter of fact "it has not been found in a single case that an uneducated deaf-mute has had any idea of the existence of a Supreme Being as Creator and Ruler of the universe."† This is manifestly decisive against the theory that the idea is innate.

The lowest savage has no religious conceptions at all. Gradually the rudiments of religion arise as ideas of forces outside himself are suggested in various ways. Mr. Spencer holds by the ghost-theory as explaining this actual beginning of religion; and he seems to be undoubtedly right in regarding it as belonging to the very earliest stages of religious evolution. But I believe there is a yet earlier and more rudimentary form of the religious feeling, excited by the apparent existence of power and volition in objects not really possessing consciousness or even life. We find even the lower animals impressed by a sense of wonder and fear when any inanimate object shows signs of apparent life

* "Algonquin Legends," Leland, p. 303.

† "Ecclesiastical Institutions": being Part VI. of the "Principles of Sociology," by Herbert Spencer. Williams & Norgate, London, 1885.

* In a sense, indeed, it was true of Darwin as Mr. Grant Allen has said, that he took the whole world of science for his special province,—which recalls Bacon's boast. But it was also true, that his mind with all its vastness was not profoundly analytical. The task of working out the psychological and metaphysical aspects of evolution fell rather to the great organising and systematising intellect of Herbert Spencer. So again in dealing with the phenomena of physical and mental heredity Darwin failed where Spencer had achieved a great success. His hypothesis of Pangenesis is "purely materialistic," as Mr. Grant Allen points out, while "Herbert Spencer's is built up by an acute and subtle analytical perception of all the analogous facts in universal nature." The former was "a singular instance of a crude and essentially unphilosophic conception endeavouring to replace a finished and delicate philosophical idea."

† "Church Work among the Deaf and Dumb," Rev. Samuel Smiles, p. 4.

and power; and I take it that among savage races a kindred feeling would long precede the more philosophical stage when the phenomena of sleep and dreams would suggest the idea of the spirit or ghost, leading a separate existence and surviving the death of the body. But undoubtedly so soon as this idea was once formed it would permeate the whole religious system of a community. In the recognition of the "double" would be found the interpretation of the apparent power and volition of objects themselves inanimate. And we can easily understand how in the course of time all plants, all animals, all natural phenomena, rain, wind, snow, cloud, sun, moon, and stars, would be regarded as instinct with life and power derived from the ancestral dead of the community. In this sense and in this way, probably, all forms of nature-worship were originally derived from ancestor-worship. It is more than probable, it may be regarded as absolutely certain, that the belief in One God by whom sun, moon, and stars, earth, air, and sea, were made, who rules all the phenomena of nature by virtue of the powers of these his creatures, was a later development, a purification of the original forms of natural religion. In every case where we can follow the progress of a people's religion to the birth of a belief in one God, we find this belief preceded by belief in many gods, and this belief again preceded by the worship of dead ancestors.

We must look then for the origin of priesthoods to the times when the vaguely-recognised powers of nature were to be influenced or propitiated, and to the later time when the spirits of dead chiefs (and in some cases even of living rulers) had to be approached with due ceremonial observances. The first priests were the medicine-men and weather-doctors, still found among various races, still believed in by the more ignorant even among civilised peoples, as our servants' faith in astrologers and wise women testifies, and as is shown by the publication of such degrading nonsense as Zadkiel's Almanac and the like. The priestly character was more fully developed, when it became part of the duties of the medicine-men to induce the spirits of dead ancestors to yield benefits or cease from inflicting evils,—by bribing them, praising them, deceiving, cajoling, threatening, frightening, or coercing them.

It was natural that in primitive communities, the chief who ruled the people and led them in battle should also be the chief priest; and equally natural that, as each community developed, these duties should be divided. The priestly duty commonly remained in the family of the chief,—being discharged by son, brother, or near relative, in some cases by the king's daughter. But gradually, the priestly race became a sect apart, descended perhaps from the royal family but no longer closely connected with the actual rulers. "Influences of sundry kinds tend everywhere," says Mr. Spencer, "to complicate, in one way or other, the primitive course of development. While we see that worshipping the spirit of the dead chief, at first carried on by his heir, is in the heir's absence deputed to a younger brother—while we see that temporary assumption of the function by a brother or other member of the family tends to become permanent where the business of the chief increases—while we see that migrating parts of a tribe are habitually accompanied by some of the village god's direct or collateral descendants, who carry with them the cult and perform its rites, and that when conquest of adjacent communities leads to an extension of rule, political and ecclesiastical, members of the ruling family become local priests; we find sundry causes at work which render this process irregular. Besides the influence which the chief or his priestly relative is supposed to have with powerful supernatural beings, there is the competing influence ascribed to the sorcerer or rain-maker. Occasionally too the tribe is joined by an immigrant stranger, who, in virtue of superior knowledge or arts, excites awe; and an additional cult may result either from his teachings or his own apotheosis. Moreover a leader of a migrating portion of the tribe, if in some way specially distinguished, is likely at death to become himself the object of a worship competing with the traditional worship, and perhaps initiating another priesthood. Fluctuating conditions are thus apt, even in early stages, to produce various modifications in ecclesiastical organisation."

The development of a monotheistic priesthood out of a priesthood essentially polytheistic, is next considered by Mr. Spencer, in connection with the hypothesis (with which, and with which alone, *all* the facts are congruous) that monotheistic ideas are developed out of polytheistic ideas. We find, for example, in the professedly monotheistic religion of the Hebrews archangels exercising powers in their respective spheres and practically demi-gods. In derived creeds we find clear marks of polytheism. As each Fiji chief has a particular god in whom he puts special trust, so, though the followers of Mahomet shed their blood and the blood of others to establish the worship of one god, the Bedouins make sacrifices at the tombs of their saints, and even the more civilised Mahometans "worship their deceased holy men at shrines erected to them." In the Middle Ages and in Catholic countries polytheistic ideas can, even in our own time, readily be recognised. Even among people claiming to have purified their religion from such imperfections, we find a doctrine at least partially polytheistic as understood by the bulk of the Trinitarian community,—without taking into account belief in Satan, which as recognising an independent supernatural power undoubtedly implies surviving polytheism. Nowhere "except among the more advanced Unitarians, and by those who are called theists, is a *pure* monotheism accepted."

Ecclesiastical hierarchies resemble the political governments with which they are associated. In societies which have developed a highly-coercive secular rule we find always a highly-coercive religious rule; and *vice versâ*. Neither the one rule nor the other can be regarded as cause or effect, but the two are developed from a common root, and for a long time can be distinguished but imperfectly from each other. The common result has a common origin in the moral nature of the people. Extreme submissiveness of nature encourages alike the growth of despotic political and of despotic ecclesiastical control; while the presence of that quality which develops in the advanced race into the sense of the dignity of manhood, resists alike the despotism of living rulers and extreme self-abasement in propitiation of deities.

Furthermore it is to be noted that ecclesiasticism in developing societies conduces to cohesion "not only between the co-existing parts of a nation, but between present and past generations." It helps to maintain those characteristics of the society which constitute its individuality. Nor is this quality of ecclesiasticism without credentials. "The life of society has, up to the time being, been maintained under it; and hence a perennial reason for resistance to deviation. Even irrespective of the relative fitness of the inherited cult to the inherited social circumstances, there is an advantage in, if not indeed a necessity for, acceptance of traditional beliefs and

consequent conformity to the resulting customs and rules. For, before an assembly of men can become organised the men must be held together, and kept ever in presence of the conditions to which they have become adapted: and that they may be thus held the coercive influence of their traditional beliefs must be strong."

Among the original offices of the priestood military functions were conspicuous. Among the ancient Germans "the maintenance of discipline in the field as in the council was left in great measure to the priests." Later the functions discharged in connection with war became more exclusively "of the kind called religious." The Samoan priest prayed for his own people and cursed the enemy. In New Caledonia "the priests go to battle, but sit in the distance, fasting and praying for victory." The priesthood among the Comanches, Schoolcraft tells us, "appear to exercise no influence in their general government, but, on war being declared, they exert their influence with the Deity." As an example of this kind of priestly action in relation to war, may be cited the following prayer directed by the chief priest of the modern English to be used at the commencement of a war in which we attacked an alien race striving to throw off an intolerable tyranny,—"Oh chief God of our people"—I have somehow got the prayer wrong, it begins "O Almighty God, whose power no creature is able to resist, keep we beseech Thee our soldiers and sailors who have now gone forth to war, that they, being crowned with thy defence, may be preserved evermore from all perils, to glorify Thee, who art the only giver of all victory," &c., &c. "The military duties of priests among ourselves have" indeed "dwindled down to the consecration of flags, the utterances by army-chaplains of injunctions of forgiveness to men who are going to execute vengeance, joined with occasional prayers to the God of love to bless aggressions provoked or unprovoked."

It must be conceded however that while pagan priests have superstitiously sought for some sign of divine approval before praying for God to assist the fighting men of his tribe, the Christian priest has with calm superiority taken that approval for granted. There was something especially impressive in this confidence when God was invited to bless our efforts in attacking a people who fought against one of the foulest tyrannies the world has known.

Social development tends to restrict the civil as well as the military functions of a priesthood. In advanced societies we find that so far from taking a leading part in civil affairs, priests are almost excluded from them. In this country for example, many of the functions once exercised by ecclesiastics have now passed from their hands; and there are some who are so intolerant as absolutely to doubt whether even the magistracy should be open to clergymen, and to question the wisdom of some of the decisions by which clerical magistrates have astounded lawyers.

Passing over the special question of Church and State considered in the last number of Knowledge we note that Nonconformity, as representing freedom of thought and including what is specially called Free Thought, is a development only found in advanced societies. "The multiplication of sects," as Spencer well observes, "with which England is reproached by foreign observers, is—philosophically considered—one of her superior traits: for the rise of every sect, implying a reassertion of the right of private judgment, is a collateral result of the nature which makes free institutions possible." "Nonconformity increasing as industrialism has developed, now characterises in the greatest degree those nations which are most characterised by the development of the industrial type—America and England."

The moral influence of priesthoods has in every age been subject to the needs of those rulers or ruling orders of which priests have been either the guides or the servants or both. They have always inculcated obedience to the powers that be, so long as these powers have trusted properly in priestly influences, and have sufficiently supported priestly powers. Moral shortcomings may be forgiven—alike in people and in priests—so long as "subordination is manifested with sufficient emphasis."

Of the future of ecclesiasticism, it is sufficient to remark that, as the idea of propitiation is lost, or as men learn to regard it more clearly as an idea essentially degrading to themselves and insulting towards the unknown Power working in and through all things, all observances implying this savage (or at its best essentially weak) thought will disappear; "yet it does not follow that observances will lapse which tend to keep alive a consciousness of the relation in which we stand to the Unknown Cause, and tending to give expression to the sentiment accompanying that consciousness. There will remain a need for qualifying that too material and prosaic form of life which tends to result from absorption in daily work; and there will ever be a sphere for those who are able to impress their hearers with a due sense of the mystery in which the origin and meaning of the universe are shrouded."

DR. W. B. CARPENTER.

THE sudden death of Dr. W. B. Carpenter, under circumstances of a most painful character, is one of the saddest events science has had to chronicle for many years. Science has also sustained a serious loss. It is true that Dr. Carpenter had accomplished fully the original scientific research which has made his name illustrious. It may even be that advancing years and failing strength might shortly have obliged him to seek rest from the work of scientific teaching—especially by lectures—which to the last he did so well. But it is almost impossible to overestimate the value of such teaching, addressed to the general public, by men such as he—veterans from the campaigns of science, recognised leaders in their own line, and known to be thoroughly competent to estimate the full value of the work being done by those who have more recently entered the field. If Dr. Carpenter did not actually teach the more advanced lessons of later writers, if he did not insist upon results to which these later labours tend, he did not reject either those lessons or their results. He had his reasons, and in our judgment they were sound ones, for caution in the exposition of views which startle and even offend the minds of the unscientific—for whom during his later years he chiefly laboured. As he wrote to the Newcastle Sunday Lecture Society (whose president he was) only harm is likely to be done by dwelling on the changes of opinion which advancing knowledge requires,—the steady teaching of the truths disclosed as scientific inquiry proceeds is all that is really required to cause error to die a natural death. Another thought presented in that letter indicates the tenor of Dr. Carpenter's labours in later life. The lecturer's main object, he said, should be to set his hearers thinking,—

not to define for them what they should accept and believe.

Of the details of Dr. Carpenter's work we do not profess here to speak. Already a full account has been placed before the public. Our object (in the very limited space which was available in these pages, when the news of his death reached us) is to touch on the general purport of his life-work.

Dr. Carpenter took an important part in the researches by which the doctrine of biological evolution was established. If he maintained to the last that "natural selection leaves untouched the evidence of design in the original scheme of the organised creation," it does not follow that his views were at all out of harmony with those which the most advanced thinker of our age has expressed when he says that our conception of the Ultimate Energy of the Universe, being given through phenomenal manifestations "can in no wise show us what it is."

Dr. Carpenter's treatise on "Comparative and Human Physiology" will remain always on the same level with such works as Herschel's "Outlines of Astronomy" and Sir Chas. Lyell's "Principles of Geology." His "Mental Physiology," apart from its scientific value, is one of the most interesting books in the English language. His labours and inquiries in regard to the deep seas were very fruitful, and although it has always seemed to us that he viewed the mechanism of oceanic circulation from the wrong end (regarding the melting of Arctic ice—an effect—as the prime moving cause), there can be no doubt that he did much to correct long-existent errors in that matter. He honoured many societies by accepting various "distinctions" which they offer to the distinguished, and which the undistinguished anxiously seek. As Registrar of the University of London, he contributed greatly to the value of the University system, and widely extended its influence. Born in 1813, Dr. W. B. Carpenter died on the morning of Tuesday, Nov. 10, 1885, in his seventy-third year. His death was the result of a terrible accident—the only consoling feature being that after the first fearful shock the power of suffering was destroyed, insomuch that he passed the last hours of his life in tranquil sleep.

MR. FREDERIC HARRISON ON THE RELIGION OF HUMANITY.

It is pleasant after the noise and turmoil of election struggles, after being forced to hear so long the harsh discords of abuse and recrimination, after being reminded yet once more that poor humanity cannot even try to advance its own cause without the way being stopped by squabbling politicians (eagerly proclaiming themselves the only leaders, their rivals impostors and worse), to turn to a quieter atmosphere, and to remember the moral issues really involved in political movements.

In his address on "Politics and a Human Religion" at the beginning of last month, Mr. Frederic Harrison dwelt eloquently and earnestly on the light which political contests throw upon the actual value of the religions, the creeds, the ethical systems which contend for men's allegiance.

"A religion, or a moral system of any kind, ought," he says, "to teach us how to live, how to do our duty in the sphere in which we find ourselves. And few kinds of duty can be more real than to ask what should be the spirit and aim that we should give to the government of our country. 'How to make the best State' was the problem presented to ancient philosophers. Tell us, ye religions, ye gods, ye gospels, ye new philosophies of ethic and of evolution—in what spirit shall we vote—by what signs shall we know the sound policy, the best statesmen?"

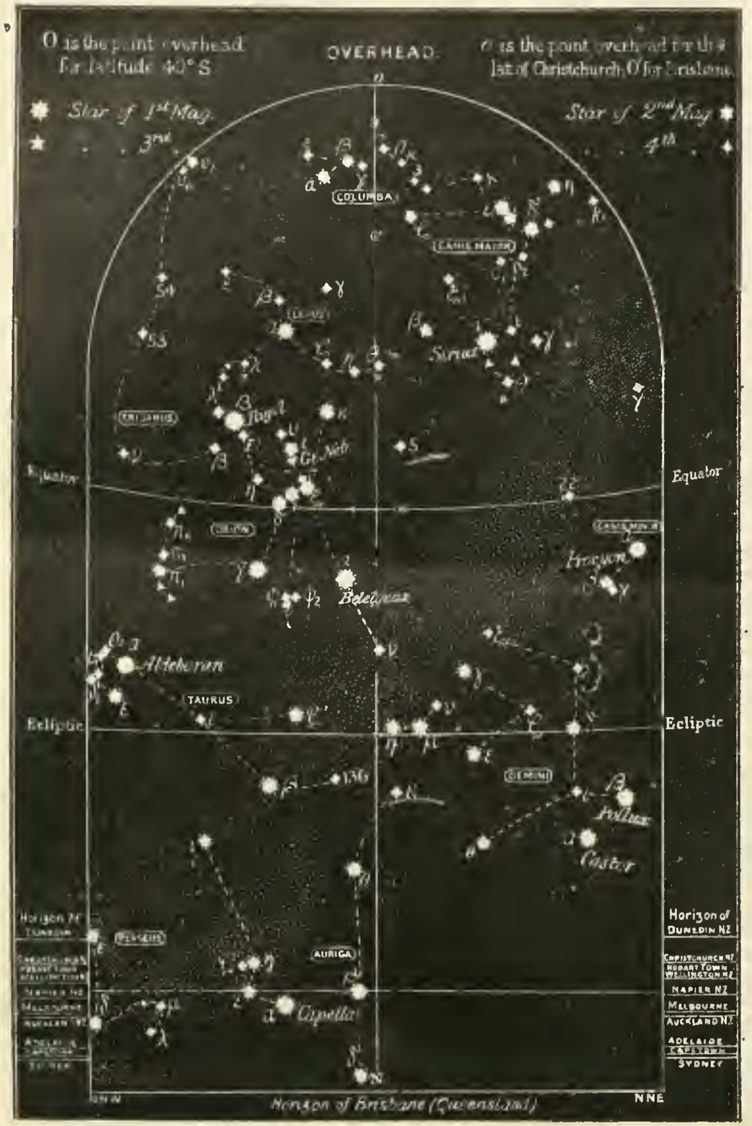
He answers, "They are dumb. Or, when they do speak, our conscience cries out—Would that they *were* dumb!"

"I am as deeply convinced," Mr. Harrison goes on to say, "as any follower of Christ can be, of the moral beauty of much in the Gospel teachings: of the personal holiness that it can still inspire, especially in the home and in the silent communing of the heart. But the organic weakness of the Gospel is in the world, in public life, in politics, and the higher righteousness of the wise and brave citizen."

Mr. Harrison is no less outspoken against what he terms "the silent, unshaped, but widely prevailing belief that all religion of any kind is *no matter*, that religion has come to an end and has left the earth for ever." "It is impossible," he says, "to argue with those in whom cynicism and self-engrossment have dried up the very fountains of human sympathy and ideal enthusiasm. But to all who retain these sacred springs of moral elevation within their souls, to those who have ever known the hallowed emotions of home, of parent, child, wife, sister; of friendship, of kinship, of patriotism, to those who have ever tried to hold up to their children a standard of right and an object of reverence, to those who in any relation of life have ever known the potency of a high motive and a noble resolve in a social cause:—to all of them we will say 'can you doubt that man's political activity, like his personal and family morality, like his social honour and his good name in his daily work, must be stimulated and guided by a genuine human enthusiasm?'"

He turns next on those who should be his natural allies, those who in trying to learn the laws according to which humanity and the religion of humanity have been evolved, show a thoroughly "genuine human enthusiasm," and indicate the only road along which the advance which he desires can be hopefully attempted. He indicates afresh his seemingly hopeless inability to understand the real bearing of the doctrine of evolution on the religion of humanity. "Will every passion," he asks, "that is known to politics, be exorcised by lectures on the laws of physical development and the analogies which are found in the embryonic morphology? Will ambition be tamed by appeals to the 'survival of the fittest'? Will 'Natural Selection' by itself make a prosperous commonwealth; or will a true patriot be bred by a course of study of Protoplasm? Why, you had far better, for the formation of character and the duty of a citizen, go to the 'Sermon on the Mount' as your guide, with all its extravagance of morbid quietism, than go for your guide to the 'Origin of Species,' with all its wealth of scientific suggestion. Nay, the transcendentalism of 'Cosmogony' is even more alien to the duties of active patriotism, than is the transcendentalism of the 'Kingdom of Heaven.'"

He fails to see that moral enthusiasm, resting on social forces by which, as he truly says, human duty and human character must be trained, is itself a product of evolution. "The battle of justice and injustice, selfishness and self-devotion, folly and wisdom, in the ordering of nations, need the highest controlling powers to which men can appeal. They compel us to resort to human enthusiasm



The Northern Sky at 10 P.M. Jan. 20, at 9 P.M. Feb. 4, and 8 P.M. Feb. 19.

The Stars seen towards the north from southern latitudes, and towards the south from northern latitudes, at 10 P.M. January 20, at 9 P.M. February 4, and at 8 P.M. February 19.

and social devotion—that is to a human religion." He is right in this beyond question. But all the more need is there for the recognition and mastery of the laws according to which human enthusiasm and social devotion have been evolved and will hereafter be developed. It is to the study of evolution, which he so despises, that he must turn even for the evidence on which his own opinion is based.

In fact, while Mr. Harrison is probably the ablest, as certainly he is the most eloquent advocate in England, of what is strangely called the Religion of Humanity, there is no man living who has implicitly expressed more utter hopelessness as to the future destiny of humanity.

Doubtless he feels as he says, "A deep and living trust that the mighty stream of human civilisation is not destined to waste itself like the Rhine in trackless swamps, but will pass on whilst the race continues, in a fuller and stronger tide; a trust that this mighty stream is one which each little drop of our own lives can deepen and swell, whilst it gives to that drop a true course, and a value in the sum of all things." Yet he has rejected and opposed Herbert Spencer's teaching that in all the religious systems the human race has known there is a common element of truth. And how can humanity, with all that its history teaches of the universality of the religious feeling, be presented in a more utterly hopeless case than by the teacher who thus maintains that hitherto the mighty stream of human civilisation *has* wasted itself in trackless swamps?

On the other hand, he who believes that there is a common element of truth in all the religious ideas men have held, who sees that the progress of the human race implies the action of a law of evolution of which the sense of duty, the desire for advance, the enthusiasm for good (even the earnestness of Mr. Frederic Harrison and his zealous fellow-Positivists) are products, may reasonably hope for what Mr. Harrison sees in the future of humanity but should logically reject.

THE SKIES OF THE SOUTHERN HEMISPHERE.

By Richard A. Proctor.

I GIVE another example of the sky seen from our northern hemisphere towards the south, and from the southern hemisphere towards the north, each map being shown on the same plan and scale. Next month I begin the series of twelve maps of the southern skies, on the plan which I have already adopted for the northern skies, only that instead of latitude 51½ degrees south, which would only suit Patagonians, I adopt 38 degrees south, which suits well all the most important centres of population in the southern hemisphere.

The American barque *Crusader*, Captain C. H. Scott, has been lying in the Regent's Canal Dock for inspection. The *Crusader* has just made the first successful transatlantic trip with a cargo of refined petroleum in bulk. This is the initial movement in what promises to revolutionise the present system of ocean transportation of petroleum, turpentine, and other liquids.

In 1874 there were 117 rag-stores in Marseilles, of which forty-six were in one district. In that district the number of dead from small-pox was three times larger than in any other district, while of 157 cases of death sixty-four occurred in rag-pickers' houses or in houses in close proximity to rag-pickers' or rag-stores. In that district M. Gilbert found a cellar, a secret store-room for rags, which infected six persons, of which four died.

CHARLES DARWIN.*

IT is understood that Mr. Francis Darwin is engaged upon a biography of his famous father, and from the ampler materials at his disposal we may expect fuller details concerning Mr. Darwin's inner and domestic life than are given in this luminous and well-proportioned monograph which Mr. Grant Allen, with the concurrence of Mr. Francis Darwin, has prepared. But the more official story can hardly make the man in all his lovable simplicity, modesty, and sweet temper of mind, better known to us, neither supply a clearer summary of his work during the long years when, possessing his soul in patience, he was accumulating the enormous data on which his immortal theory is founded.

Written with that grace of style—happy vehicle of accurate statement—which is the characteristic of Mr. Allen's work, and which enables him to make the rough ways of science easy to travel over; indeed, so easy that one's only fear is lest the cursory reader may think he has the Darwinian theory at his fingers' ends—this is not a book to be borrowed from Mudie's, but to be read, inwardly digested, and then assigned a place on the shelf by the side of Huxley's "Hume."

The volume opens with a prefatory sketch of the state of biological science at the time when Darwin was born, and traces the shadowy, undeveloped shape in which the theory of evolution which he was to convert from a guess into a certainty then existed. In the following chapter, perhaps the most interesting in the book, Mr. Allen consistently applies the theory of descent with modification, the "evolution of the evolutionist," to his subject, tracing the physical and spiritual ancestry, alike rich and varied, from which Darwin derived his wealth of energy and intellect. Limited though his space is, Mr. Allen succeeds in presenting in a few sharp lines the striking personality of the grandfather Erasmus Darwin, between whose rhapsodical rhymes on the "Loves of the Plants" there are scattered sober descriptions indicating partial glimpses of the theory of which the grandson had full vision.

In the generous spirit of Darwin, who was sensitively anxious to acknowledge his debt to the past, Mr. Allen has played the part of Old Mortality in restoring the obscured names of men who had applied the theory of natural selection in detailed instances, yet had failed to grasp it as a universal. Such, among others, were Patrick Matthew, in his book on naval timber; Dr. Wells, in his speculation on the production of varieties in the human race; and, in a limited degree, Sir Charles Lyell. But, as Darwin himself states in a letter to Haeckel, quoted by Mr. Allen, it was to the much-maligned and gentle-souled Malthus that he was most indebted for the idea of *natural selection through the struggle for existence* which is the central idea of the theory called after Darwin's name. "Darwinism," as Mr. Allen remarks, "is Malthusianism on the large scale; it is the application of the calculus of population to the wide facts of universal life."

No heed should be paid to Mr. Allen's suggestion that his analysis of the theory of natural selection be skipped, for even to those who are familiar with Mr. Darwin's numerous works, the synopsis given of the more important among them, notably of the "Origin of Species," is refreshing to the memory. With the monitory illustrations of arrested development which are supplied in the ossified intellectual state of *savants* who have shrunk from accepting conclusions drawn

* "Charles Darwin." By Grant Allen. Longman. 1885.

from data largely gathered by themselves, Mr. Allen only discharges his duty in including man, spiritual as well as physical, as a product of Evolution, and in applying that theory all round, from the embryonic universe to the embryonic soul. One feels in closing this book how happy was Darwin in his circumstances, how happy in his use of them, and in the recognition which he so quickly reaped. For some work the test of time, the perspective of ages, is needed. The fashion of this world passeth away, and we can rarely predict that its changes will not touch many whom their contemporaries most delight to honour. But we have a sure word of prophecy that no change can impair the value or retard the universal application of Darwin's theory, neither blot from human memory the stainless record of his simple, yet momentous life.

THE CHERSONESE WITH THE GILDING OFF.*

TO her very interesting sketch of life in the Malay Peninsula, Mrs. Innes has given the above title in reference to Miss Bird's book, "The Golden Chersonese." As she says, her own account and that of Miss Bird are both essentially true, although very different, owing to the fact that, whereas Miss Bird travelled under favourable circumstances, everything being made as easy for her as possible by officials who were anxious to win her approbation, Mrs. Innes lived for six years in the country, subjected to trials, dangers, and sufferings, and without receiving any assistance from her husband's fellow-officers under Government. Mrs. Innes deals in a masterly way with men and manners, and has managed so to arrange her narrative that there is not a dull page in it from beginning to end. Subjects which in other hands would be uninteresting, she tempers with ever-ready wit, treating what we should call hardships as amusing trifles, but leaving her readers none the less impressed with her fortitude and personal courage. Perhaps this characteristic is most striking in her description of the murder of Captain Lloyd at Pangkor, at a time when she was staying with that gentleman and his wife. Mrs. Lloyd and Mrs. Innes only escaped death by accident, the murderers, a band of Chinese robbers, having left them for dead in their rooms at the Residency, where they were afterwards found by the Malay chief who came to their assistance. Writing from hard experience, Mrs. Innes would dissuade Englishmen from undertaking the position of collectors in Native States under Protection; the hardships of such positions are many, and the expenses so great, that the salaries given are quite insufficient; moreover, the Government so neglects the health and welfare of these officers, that their very existence is rendered difficult.

Hydrogen in Zinc Dust.—It has long been known that shippers are unwilling to carry large quantities of zinc dust in their vessels, owing to the danger of its getting moist and becoming heated to a dangerous extent. Mr. Greville Williams, F.R.S., has recently made some researches which throw light on this matter. He finds that wetted zinc dust, after drying, gives off nearly double the hydrogen that unwetted dust gives. Hydrogen is absorbed from a moist atmosphere at moderate temperature by zinc dust. It has, in fact, the power of occluding hydrogen after the manner of spongy platinum.—*Engineering.*

* "The Chersonese with the Gilding Off." By Emily Innes. (R. Bentley & Son, London. 1885.) 2 vols.

SOMETHING ABOUT MYNAS.

[Communicated.]

IN my remarks about sparrows I was rather severe upon their character generally, showing that there was nothing lovable about the crew. Far different is it with the dear, gentle, sprightly, and highly-amusing Mynas. Their sub-family, the Sturninæ, are represented at home by the Starling (*Sturnus vulgaris*).

Our Mynas are natty and sprightly, pleasant in plumage and voice, and singularly amenable to domestication.

The common Myna, known all over India, is unhappily characterised by the dreadful name, "*Acridotheres tristis.*" Fortunately it is neither "acrid" nor "tristis," but whether it may turn out "otheres" I don't know.

It is a very social bird, always associates in flocks, which coalesce at night, and separate in the morning with enormous chatteration.

Like the sparrow, this species always affects human society; but, unlike the sparrow, it does not depend on us for food. It is very fond of building its nest in the eaves of our thatched houses, or amongst the beams supporting the thatch; but, unlike the sparrow, it rarely, if ever, nidifies within doors.

I met with an exception at Peshawar, where, in our dining-room, a pilaster ran up one wall about a foot short of the roof, and afforded a platform of about 18 in. by 4 in. The house had been standing empty, and when we took possession we found that this precarious spot had been appropriated by a pair of Mynas, which had originated a perfect mound of rubbish at the base of the pilaster, falling off the top.

They had obtained access through an open ventilator, and, do what we could, we could not keep the birds out, and were oppressed with their rubbish. At last, by hermetically sealing every inlet, we gained the day; but our triumph was saddened by the reproachful taps of the Mynas against the glass panes of the ventilators.

At pairing-time these Mynas are amusingly pugnacious. After much vituperation and hopping at one another, two birds seize one another by their claws, and then, assuming a sitting posture, peck furiously at one another. A crowd of chattering companions surrounds them, and if all is not fair a third will enter the lists, and there will be a triangular, and perhaps quadrangular, duel, the combatants pecking and vociferating furiously, and the onlookers yelling, "Go it this one!" or "Go it that one!"

If you interfere the crowd will adjourn to the nearest tree, and have it out there with large abuse. I once saw a pair of claw-locked Mynas fall from a tree into a canal at Peshawar. They emerged with difficulty, but only to resume the fight in the next tree. These birds have large powers of imitation, are very easily domesticated, and become docile and affectionate pets.

One of my birds caught the cry of my child so perfectly that its grandmother would toddle about the house after the suffering little one. Another coughed to perfection, but became vulgar, by learning to expectorate; and a third sneezed admirably, but became affected by drawling it out as "a whish—shaw," looking at you with one eye and resting on one leg.

The handsome *Entabes intermedia* or Nipal hill Myna, with its glossy black plumage, and orange wattles, beak, and legs, is *facile princeps* among Mynas.

This fine bird is largely domesticated for its handsome

plumage and powers of imitation, and its feats might easily form a lengthy contribution to these pages, but one must suffice, and this occurred to myself. In July, 1874, I bought a pair of fledglings, intending to take them home when we took furlough in December.

Next door there lived an eccentric medical officer, who was an amateur in snakes: until I knew him, I was under the impression that he kept an enormous farm-yard, for turkeys gobbled, geese cackled, ducks quacked, guinea-fowls packecked, cocks crew, and fowls, chased for slaughter, screamed all day long. Calling one day, I casually alluded to his farm-yard; he burst out laughing, and led me to see it. To my amazement, I found it to consist of a single cockatoo, which thus marvellously reproduced a farm-yard. Well, my Mynas hung silent in the verandah until we went home in December, remained so during the voyage, and until we settled at Brighton in the following January. One day I heard the familiar screams of "a sudden death," and, with Indian associations fresh in mind, fancied that the cook was killing a fowl for dinner.

A day or two after our landlord informed me that I was deteriorating his premises by keeping fowls, and that the neighbours would be sure to complain. On my totally denying the accusation, he replied "That he had distinctly heard various fowl-calls." Disbelieving me, I heard afterwards that he threatened the cook for keeping fowls in fashionable lodgings. Her reply was: "Lor' bless your soul, sir, them is no fowls as you hears, but them furrin' birds which master brought from the Hinjees." And so it was; the Mynas were now, in Brighton, uncorking the recollections which they had bottled up in Lucknow six months before, and we had henceforth to labour under the suspicion of harbouring a farm-yard in a fashionable neighbourhood. All that we could do, in self-defence, was to allow the Mynas to perform publicly, in an open window; but then we always had an admiring crowd of gaping cads on the pavement, which was not convenient. R. F. Hutchinson, M.D.

The Sabbatarians of St. Kilda.—The St. Kildians, says the *St. James's Gazette*, have taught a lesson to the kind-hearted persons who set sail the other day with provisions for them. St. Kilda is a dreary island in the far north, subject to periodic attacks of starvation, and a week ago a steamer left Harris laden by Samaritans with the good things of which the St. Kildians were known to be destitute. It is a comparatively easy matter to stock a ship with presents for the St. Kildians, but quite a different matter to land them. The island is guarded from the outer world by a raging sea that whirls round it unceasingly, and the relief party congratulated themselves when they managed to cast anchor close to the shore. Then they got out their glasses and eagerly scanned the island to see the half-starved inhabitants come rushing towards the steamer. To their bewilderment, not a soul was to be seen. It was a deserted island. Then a stream of people issued from the church, and the arrivals remembered that it was the Sabbath-day. Some of them scrambled ashore, and, hurrying to the chief man, asked him for assistance to get the goods landed at once, while wind and sea permitted. The chief man is the minister, and in St. Kilda he holds despotic sway. He answered the inquiry sternly in the negative. The St. Kildians had other things than food to think of on the Sabbath. Then could he guarantee, it was asked, favourable weather in the morning? for if the wind shifted the steamer would have to be off. The minister was unmoved. "He could only promise that the men would be ready to man their boats as soon as the Sabbath was out, not a minute before, and he trusted that the same Providence which had put it into men's hearts to send them corn and potatoes would keep the wind steady in the north-east." At twelve o'clock precisely the work of disembarkation began, but what were the thoughts of the St. Kildians and the relief party while they waited for the passing of the Sabbath is not told.—[The St. Kildians, through intermarriages within their own race, have so deteriorated that besides being—as above shown—semi-idiotic, half the new-born children die of lock-jaw a few days after birth. This throws curious light on the old and absurd belief that different nations descended severally from single pairs.—R. P.]

Gossip.

By Richard A. Proctor.

I have received so many letters urging that as the Replies to Correspondents (which many seem to have enjoyed!) have ceased, Editorial Gossip should at least not be discontinued, and might even be extended, that it would be discourteous on my part not to respond to the request. Therefore I have penned a few paragraphs about such matters as seemed suitable for this sort of disconnected chit-chat.

* * *

It is doubtful whether we should regard it as a quaint indication of American character, or rather as illustrating human nature, that when Mr. Shaw (Josh Billings) wrote in good English and under his own name, his philosophy fell dead; when he began to publish ill-spelt and ungrammatical philosophy, under an assumed name, he had a large number of readers. I cannot for my own part quite see why interest should be taken in reading the remark, "If yu seek wisdom, my yung friend, studdy men and things; if you desire larning, studdy dikshionarys," while the same remark properly spelt should pass unheeded. If the former version is found to be funny because ill-spelt, there must be a most imperfect idea as to what constitutes fun and humour; but if the wisdom of the saying constitutes its value, one would say that it would be at least as impressive when properly spelt as with "larning" for "learning" and "studdy" for "study." Would the American public, I wonder, rush in their thousands to buy a version of the Proverbs of Solomon in the "phunny phawm" which Artemus Ward, Josh Billings, and Eli Perkins found so attractive? Would it be more profitable to read,—"Go 2 the aunt, thow slugud, konsidr her wais & B Ys," than to read the saying in the usual form? Or again, "The larfter ov phoolz iz lik the kraklin' ov thawns undr a pott,"—would that have more influence on those who find fun in bad spelling than the saying as usually printed in our Bibles?

* * *

Americans find Englishmen very impervious to American fun, even as Englishmen find Scotsmen impervious to English jokes. A good deal may probably be said in each case on both sides; but many of the stories supposed to illustrate dulness of apprehension rather indicate, I think, a more delicate apprehension of what constitutes real wit. A joke that passes as good in one country may be regarded as no joke at all in another; but that may be because it really is a very poor joke indeed. In other cases, a joke may be taken solemnly by way of joke,—by no means from want of wit. Thus Lamb tells us that when Coleridge drew the curtain hiding his pet picture, saying to a Scottish friend, "What do you think of 'my beauty'?" the Scotsman not apprehending the sense in which Coleridge spoke of the painting as "his beauty," answered, "I think highly, Mr. Coleridge, of your abeelity, but I cannot say I think much of your beauty." And this has been quoted as a sample of Scottish obtuseness! Judging from the Scotsmen I have known, with not (I think) one single exception, that Scottish friend of Coleridge's, solemnly though he uttered his remark, made there the only joke that was missed on that occasion.

* * *

So with the Scotsman who when told that the Kilkenny cats had fought till nothing but two tails were

left, replied after a pause of seeming cogitation, "Eh, mon! but there must have been more than twa tails," had not missed the joke (or he was unlike any Scotsman I have ever met)—he was simply showing his appreciation of its point. One might as reasonably regard the solemn face of every really great humorist as proof of dulness of apprehension.

* * *

Mark Twain mistook in the same way (and oddly enough when one considers the quality of his own humour) the tone in which many English reviewers dealt with his "Innocents Abroad." Spluttering laughter is not the best way of welcoming gravely uttered jests; and it is rather pleasing than otherwise to find that Americans recognise very little that can remind them of the crackling of thorns under a pot, in our English way of welcoming their jokes, from the feeble fun of mis-spelt words to the real wit of their best humorists.

* * *

A valued contributor to these columns has expressed a wish to delete commas before "and," where three or more nouns are brought together. I find myself, in this case, a defender of the comma, who some time since fought against it. (What a convenient word the old "erst" was; here it would have done duty for three.) Logically, it seems to me, if we wish to speak of three things *a* and *b* and *c*, we ought to write "*a*, *b*, and *c*," not "*a*, *b* and *c*": for otherwise we have no means of showing, by the punctuation, whether *b* and *c* are different from *a*, or are included in the same class. For instance, if we write "the ancient inhabitants of England, Saxons and Normans," we might mean either "the Britons, Saxons, and Normans," or "the ancient inhabitants of England,—viz., the Saxons and the Normans," and though in the great majority of cases, the context, or knowledge already possessed by the reader, would make the real meaning clear, it is in my opinion always a fault of style if the real meaning of a passage has—unnecessarily—to be inferred from the context or from antecedent information.

* * *

In many cases, the omission of the comma in order to show that the words on either side of "and" are coupled, is absolutely necessary,—and a single case of this kind shows that the unnecessary omission of the comma involves a fault of style. Thus there is a passage in Cooper's "Pilot" (I quote from memory, and long-long-ago memory) in which Captain Barnstable (or lieutenant, which was it? was it not both, by the way, second lieutenant of the frigate and captain of the saucy *Ariel*?) calls to his crew, "Board her Ariels, greybeards and boys, idlers and all!" Clearly if the omission of the comma before "and" were the rule, the reader's first idea of the meaning of the appeal would be that the Ariels, the greybeards, the boys, the idlers, and all the rest, were invited to board the British cutter. The inspiriting effect of the couplings following the general call, would be altogether lost at a first reading. (I am by no means sure that the word used in this particular call was "Ariels," it might have been "you sea-dogs," or the like, but the principle is the same.)

* * *

In reading French books one often finds the omission of the comma confusing, until one has learned to notice that the spirit of the French language does not lend itself to the bold couplings which are often so effective in description.

Our English printers fell about thirty years ago into the French fashion, and I remember well how confusing the omission of the comma was in the earlier editions of Macaulay's "History of England." I collected several pages of examples of distinct double meanings, some of which were really perplexing, even when the context was carefully considered, and where the reader had plenty of previous knowledge for his guidance. Probably some awful examples of that sort led our printers to return to the more logical method of punctuation. I observe, however, that some writers, like our friend above-mentioned, adhere to the incorrect method. I notice it frequently in the writings of the Head Master of Clifton College.

* * *

It may be thought that my defence of the comma in this case is inconsistent with my objection to it before: but in reality it depends on precisely the same principle. I objected to "and, therefore," because I maintained that "and therefore" should be regarded as forming a double conjunction, not two distinct conjunctions; that in fact the "and" ought not to be separated from the "therefore." In the present case, in like manner, I regard the "and" as too closely connected with the word it precedes to sufficiently mark it off from the word it follows: the comma is as much needed as if the "and" were not there. Only when the noun following the "and" is to be associated with the noun preceding it, is the comma to be omitted; and as its omission implies this close association, omitting it between distinct nouns is wrong.

* * *

We nearly always (perhaps always) get a correct rule for using or omitting the comma, by noting whether in reading there is or is not a "commatic" pause. Now as no reader (not being idiotic) would think of reading "and—therefore" (the dash representing the commatic pause), so I take it no sensible reader would say "the Greek—Roman and Englishman—fought for liberty," with no commatic pause after Roman. If he did he would assuredly make nonsense of the sentence. On the contrary, he would read "the Greek—Asiatic and European—fought for liberty." Therefore the writer should put, severally,—

1. The Greek, Roman, and Englishman, fought for liberty,
2. The Greek, Asiatic and European, fought for liberty.

Observe also that whereas in the first sentence no comma *need* follow the third noun, a comma must follow the third noun in the second sentence. I myself prefer to add a comma after the last noun in all such cases, that is wherever there are more than two nouns, because this corresponds with the commatic pause usual in reading, and better represents the sense. For in the sentence "the Greek and Roman fought for liberty" the Greek is related to the verb as closely as is the Roman; but in the sentence "the Greek, Roman, and Englishman fought for liberty," the Greek and the Roman are cut off from the verb severally by a comma, so that the three nouns to which the verb equally relates are not equally connected with it—which cannot be logically sound.

* * *

I may remark that my own views about all points of punctuation depend absolutely and entirely on clearness of meaning. I make no rules. I simply test each sentence by inquiring what meaning will be given to it by the reader, if punctuated in this or that way and read as punctuated. Among other points which I have been

led to notice in following out this plan, has been the necessity, for scientific and philosophical writing if not for narrative, of a point which would serve as (and might be called) a half-comma.

* * *

My attention has been called to a suggested method of measuring the sun's distance, depending on determining the time when the moon is half-full before and after "full." Theoretically this method is excellent—(it is practically the same which was suggested by Aristarchus of Samos, as described in my book on "The Sun"). The arc traversed by the moon from half before "full" to half after "full" is greater by about 18′ than the arc traversed from half after "full" to half before "full"; for the moon's orbit round the earth (not that she really travels round the earth) subtends about 18′ as supposed to be seen from the sun. In reality, the application of the method effectively, requires that the observer should not only detect but measure accurately within at least one 300th part, the interval of time between the moment when the moon is really half full, and the moment when the sun and moon are 90° apart on the celestial sphere, this interval being the time occupied by the moon in traversing 9′ or one 2,400th part of her apparent orbit round the earth. This would be about 18 minutes of time, and certainly no one who has ever studied the half moon with a telescope would hope to tell within 18 minutes the moment when, taking fair account of her inequalities, she might be regarded as half full. But to get the sun's distance out of this method, with accuracy equalling that already obtained by other methods, the observer would have to determine the moment of true half moon within less than four seconds!

* * *

Reading the last paragraph, I feel that an apology is due to those who are enthusiastic about the dignity of science, for my omission of the sweet word "dichotomy" and its cheerful derivatives. I hasten to make them happy by explaining what I really mean—viz., that no reliance can be placed on the method suggested by Aristarchus for determining the mean equatorial horizontal solar parallax by chronometric observation of the lunar dichotomy.

* * *

I am glad to be able to announce that the change from weekly to monthly Knowledge has apparently met with general approval and has at any rate begun most favourably. Many regret the weekly; but their regrets have been expressed in the kindliest way, and always with promise of support to the monthly.

* * *

We propose soon to begin a series of studies of Shakespearean Characters, by a Student of Shakespeare, each character being made the subject of a single article.

New Books to be Read—and Why.

The Dictionary of National Biography. Edited by Leslie Stephen. Vol. IV. Beal-Biber. (London: Smith, Elder, & Co. 1885.)—Because it is the fullest, most accurate, and most complete compendium of British Biography extant; including such diverse lives as those of Edmond Beales, of Hyde Park railways notoriety; Aphra Behn, Cardinal Beaufort, Sir Henry de la Beche Bewick, the wood-engraver; and Bishop Berkeley, amid a whole host of others.

A Short History of the Netherlands. By Alex. Young. (London: T. Fisher Unwin. 1886.)—Because, without going into the detail, or in any legitimate sense attempting to rival Motley's imperishable work, Mr. Young gives a trustworthy and scholarly history of the Netherlands in a compact and readable form.

History of Astronomy During the Nineteenth Century. By Agnes M. Clerke. (Edinburgh: Adam & Charles Black. 1885.)—Because, although guilty of the questionable taste of conspicuously puffing a notorious self-advertising "astronomer," the authoress has, on the whole, given us a fair and pleasantly-written record of the progress of astronomy during the last eighty or ninety years.

Horse and Man. By the Rev. J. G. Wood. (London: Longmans, Green, & Co. 1885.)—Because it contains a mass of information of the highest value to every man who keeps a horse either for pleasure or profit. Owners of carriage horses who use—or whose servants use—the wicked "gag" bearing-rein, should study Mr. Wood's text and its illustrations.

Wanderings of Plants and Animals. By Victor Hehn. Edited by J. S. Stallybrass. (London: Swan Sonnenschein & Co. 1885.)—Because, though diffuse, it contains a great deal of information on the original habitats of animals and vegetables now very widely removed from them.

Farm Live-stock of Great Britain. By Robert Wallace. (Edinburgh: Oliver & Boyd. 1885.)—Because the agriculturist will find much that is of value to him in connection with the management of the solitary element in farming which at present affords the slightest chance of remuneration.

That Very Mab. (London: Longmans, Green, & Co. 1885.)—Because it is a very witty and amusing satire upon contemporary crazes; characterised by much of Swift's trenchant keenness, while wholly devoid of his coarseness.

Hugh's Sacrifice. By Cecil Marryat Norris—*Through a Refiner's Fire.* By Eleanor Holmes—*A Generous Friendship*—*Girlhood's Days*—*Master of his Fate.* By A. Blanche—*The Daisy* (London: Griffith, Farran, & Co.)—*When I was a Child.* By Linda Villari (London: T. Fisher Unwin)—*Prudence Winterburn.* By Sarah Doudney (London: Hodder & Stoughton)—Because, if not reaching the highest level of fiction, they are all sound, healthy stories for the young, containing good morals, and are, in more than one case, decidedly interesting.

From the Tanyard to the White House. By Wm. M. Thayer. (London: Hodder & Stoughton.)—Because it contains a biography of General Grant which will interest boys (though we earnestly wish that Mr. Thayer would never try to be funny).

Queer Pets. By Olive Thorne Miller. (London: Griffith, Farran, & Co.)—Because it puts natural history in an attractive and amusing light for children, who are never cruel to their own actual pets.

The Missing Man. By H. Sutherland-Edwards. (Remington & Co. 1885.)—Because it is a novel of much more than ordinary interest. Belonging to the new school of cheap sensation novels inaugurated by Hugh Conway, it is nevertheless a work written with great care, so that the uncomfortable feeling of impro-

bability which so often tinges books of this class does not here obtrude itself, at any rate to those familiar with the annals of mental pathology. The madness of Lord Pontefract, who, after a severe shock following upon great mental exhaustion, is led to believe that he is a certain John Robson, by whose troubles he has been greatly impressed, is a skilful psychological study, and his sudden recovery of his personality is equally well drawn. Although the general reader will probably hardly appreciate the genuine merit of the book, the interest of the plot is so great that it cannot fail to become very popular.

There also lie before us, each addressing its own public, *Technical Gas Analysis.* By Winkler & Lunge (London: Van Voorst. 1885)—*Scientific Meliorism.* By Jane Hume Clapperton (London: Kegan Paul, Trench, & Co. 1885)—*Jacob Boehme.* By H. L. Martensen (London: Hodder & Stoughton. 1885)—*Euphorion.* By Vernon Lee (London: T. Fisher Unwin. 1885)—*The Imperial Parliament Series* (London: Swan Sonnenschein & Co.), and numerous serials.

A Metropolis of the North.—Newcastle-upon-Tyne is well-known the wide world over as the great emporium of the coal-trade, which has been carried on here since the days of Henry III., and is popularly supposed in the south of England to be a city peopled by coal-miners, and having coal-mines, in full tide of work, plentifully scattered amongst her streets. Yet you will rarely see a pitman there, except on market-days, when they flock in from the country round, easy to recognise by their gait and their peculiar complexion, which is pale, yet robust and healthy-looking; while, as for coal-pits, there is only one within the city bounds, and that only started work about two years ago, after lying idle some quarter of a century. In the neighbouring country side they are plentiful enough: in some directions as you approach or leave the city, you will see their engine-houses, and the tall, skeleton framework of their coal-drawing gear, looming black against the sky on every side. On Newcastle Quay, the headquarters of the Great Northern coal-field, you will scarcely see a single piece of coal, though as for the offices of the coal-fitters—the successors of the ancient hoastmen of the town, who regulated the vend of coal far back in mediæval times—their name is legion. All down the Tyne and in the docks you will see huge spouts projecting over the water at the ends of the long railways or waggon-ways, which run from the collieries, sometimes miles away; and under these spouts you will see vessels lying, taking in the coal for transport to the furthest ends of the earth.—*English Illustrated Magazine.*

Ants.—Sir John Lubbock gave a lecture on ants at the Royal Victoria Hall, Waterloo-road, on the 3rd Nov., Mr. S. Morley being in the chair. After describing how he kept his ants, and stating that he had two queens which he had had since 1874, the lecturer showed on the screen pictures of queens, males, and workers of various ages. Ants of the same nests never quarrel, but those of different nests are always at war. In order to see whether ants of the same nest recognise each other by means of a password, Sir John Lubbock had made a number of ants belonging to two nests helplessly drunk, and laid them near one of the nests. The sober ants carried most of their friends into the nest, but threw all the strangers into the water which surrounded it. After discussing the powers of smell, hearing, and sight in ants (the last apparently not helping them much to find their way), experiments were detailed on their power of communication, the conclusion being that they can tell their friends of treasure and guide them to it, but do not describe the way to it. After remarks on the industry of most ants and the helplessness of certain slaveholding kinds, which cannot even feed themselves without help, living specimens were projected on the screen of the red slaveholders and black slaves, which had been stolen from their homes in the chrysalis state. Also English queens and workers, and the small blind white insects, found only in ants' nests, and supposed to play the part of domestic animals to the ants. The lecturer concluded by expressing an opinion that the mental powers of ants differed from ours rather in degree than in nature. In thanking the lecturer, Mr. Morley spoke of the science classes lately started at the hall, and enlarged on the advantage to working men, even from a money point of view, of such classes. He announced that Mr. W. L. Carpenter would give a lecture on the 10th, entitled "Fire! Fire! or the Electrical Fire-alarm System in America."

Our Chess Column.

By Mephisto.

AN HOUR WITH A CHESS-MASTER.

MY friend having won the great Tournament, I hastened to offer him my congratulations. I assured him that although I often said (in fun, of course) that he would never eclipse Morphy, yet I always considered him a great player. Having offered sufficient homage to the victor, I asked him, for friendship's sake, to show me his best game. "I am afraid," said he, "that there is a difficulty in the matter; you might wish to see a brilliant game. I could show you several good ones, but my best game is a comparatively dull one." "Pray," said I, "explain the contradictory character of your remark." My friend assumed a dogmatic tone in replying as follows:—

"The finest game is one in which the finest and most brilliant combinations and positions occur. The best game, however, is that in which the attack meets with a strong and stubborn defence, and in which a result either way is obtained by sheer hard play and correct judgment. A well-fought game gives me far more satisfaction than a game in which the opponent's weak play induces brilliant combinations."

"Well," I said, "I do not wish to dispute the point with you, but pray show me a real hard-fought game. Not that I wish to admit your reasoning; but, as I have had the pleasure of playing over most of your brilliant games as they appeared in print, your game will show me your style of play different to what I have seen before."

My friend consented, and showed me one of his games, which I here reproduce, together with his remarks thereto:—

White M. W.	Black X.
1. P to K4.	P to K3.

I played the French Defence because my opponent was a very good player, and knew more of the Ruy Lopez than I did. In that case it is much safer to adopt the French Defence, it being easier to handle than the Spanish.

2. P to Q4.	P to Q4.
3. Kt to QB3.	Kt to K B3.
4. B to K Kt5.	B to K2.
5. P to K5.	

I am not at all satisfied that P—K5 cannot be played with advantage against the French Defence, either on the second-third move or as in this game.

5.	K Kt – Q2.
6 B × B.	Q × B.
7. Q Q2.	

Preparing himself for a long struggle, White wants to support his centre by playing his Kt to Q sq and K3—undoubtedly a good position.

7.	P to QR3

I intend advancing on the Q side, beginning with P to QB4. I must, however, play P to QR3 first; for if 7. P to QB4, 8. Kt to Kt5, followed by posting his Kt on Q6.

8. Kt to Q sq	P to QB4
9. P to QB3	P to B5

It is often injudicious to advance this P too early, as sometimes P to Q Kt3 threatens a break-up on the Q side, especially before the QBP has been moved. Another danger is on the K side from the KBP, which, if sufficiently supported, might attack the centre Pawns *viâ* KB5. An isolated KP or QP would then become a source of weakness.

10. P to B4	P to Q Kt4
11. Kt to B3	B to Kt2

A vague move. To meet a possible advance of the White KBP later on, the B must remain on B sq.

12. Kt to K3	Kt to QB3
13. B to K2	Castles KR

White already threatens P to B5, but in that case I should now play P to B3, which is the only way to meet this move, although, as before said, the Black QP would become isolated after BP × KP.

14. Castles KR	P to B4

I wanted to get rid of the danger arising from P to B5.

15. P × P (*en pass*)	Kt × BP

This weakens my game, but on the whole I thought it better than P × P.

16. Kt to K5	Kt to K5
17. Q to B2	P to Kt5

I must utilise my advance on the Q side to weaken his Pawns there, as against my weak KP.

18. P to QR3	P × BP

I did not see any good in advancing P to Kt6. I cannot attack his QKtP, and the Black position would give White more freedom of action on the K side.

19. P × P — Kt to R4

I made up my mind that the unsupported QBP or QRP should be the objects of my attack.

20. P to KKt3

White wishes to displace the Kt, and protects the KBP before playing B to B3. Kt to Kt6

20. (See diagram No. 1.)
21. R to R2 — QR to B sq.
22. B to B3 — Kt to Q3

I thought it best to retain my Kt to attack the P's *via* Kt4. If 22. Kt (Kt6) to Q7, then White plays 23. B × Kt, and I cannot play Kt × R, on account of 24. B × P (ch)!

23. P to QR4 — Q to K sq.
24. B to Kt2 — P to Kt3

I must prevent P to B5.

25. Q to K2 — R to QB2

I make the R available to protect the K, in case of an advance of P's on the K's side.

26. R to K sq.

White wants to displace the Kt by Kt to B sq. and Kt to Q2,

26. — R to KKt2

an unnecessary move. Black would only weaken his position by playing P to Kt4

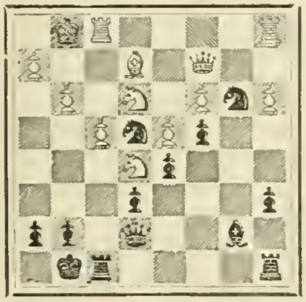
27. Kt to Bsq — B to Bsq
28. Kt to Q2 — Kt × Kt

White could always force the exchange by R to Kt sq. I could not retake with the P.

29. Q × Kt — R to Kt2
30. Q to QB2

Diagram No. 1.

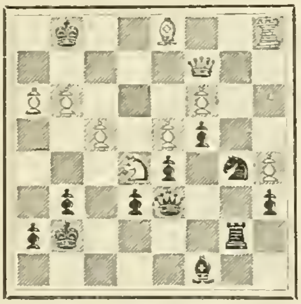
White.



Black.

Diagram No. 2.

White.



Black.

This game is played with a steadfast purpose by both sides, White operating against the K's side, whilst Black pursues his advantage on the Queen side. Every move is the result of deep thought. White now has Kt to KtP in view for a future contingency.

Kt to B2

31. Kt to Kt4 — Q to Q sq
32. P to R5 — R to Kt4
33. KR to R sq — Kt to Q3
34. Kt to K5 — Q to B2

To avoid giving White a chance for a draw by Kt × KtP; also to prevent Kt × B6 and Kt to QKt4.

35. R to Kt sq.

An excellent move, as it disposes of the R. If now R × P, 36. R × R, Q × R. 37. Kt × P.

35. — K to Kt2

To stop Kt × P

36. R × R — Kt × R
37. P to R3 — Q to Q3
38. R to R sq. — R to K sq.
39. B to B3

My opponent strained every nerve to gain an advantage. He had formed the far-reaching plan of placing his B on QB2, from where he would be available for attack on the KKtP, assisted by the KRP. The B would also prevent my occupying the sq. on QKt6.

39. — R to K2
40. B to Q sq. — R to Kt2

(See Diagram No. 2.)

41. Q to Bsq — Q to B2

My intention was to attack the RP threefold by Kt to Q3, R to Kt4, and Kt to Kt2.

42. P to R4 — Kt to Q3
43. B to B2 — B to Q2

I deemed it prudent to bring the B in support of my KKtP.

44. Q to R3 — B to Ksq

I cannot, of course, move my Kt without moving the B.

45. R to Ktsq — R × R (ch.)
46. B × R — Kt to Kt2

You will see presently the depth of White's play. Beginning with 44. Q to R3, he induced me to play for the RP, because at last he saw his chance to get at my KP in a roundabout fashion. His idea was as deep as it was correct, and played with analytical profundity.

47. B to B2 — Kt × P.

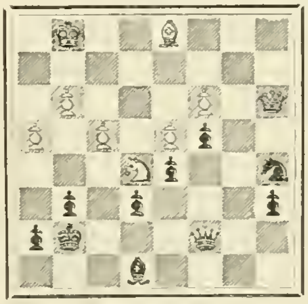
At last my arduous efforts after the P succeeded, but so far from the game being decided, the real struggle only began after this, leading to a most interesting ending.

48. B to Q sq.

Now I was in a fix. I could not withdraw the Kt without losing the RP: I could not play Q to Kt3 on account of Q to K7; and, finally, B to Kt4 was threatened by White. In this difficulty I determined to give up two Pawns, force the exchange of Queens, and make a bold advance with the QRP. It was hardly sound play, but it succeeded in extricating me from my difficulties. (See Diagram No. 3.)

Diagram No. 3.

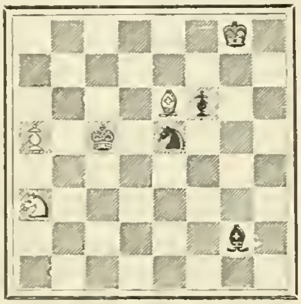
White.



Black.

Diagram No. 4.

White.



Black.

48. — B to Kt 4
49. B to Kt4 — Kt to Kt2

You see I have the courage of my opinions.

50. B × P — Q to Q3
51. Q × Q — Kt × Q
52. K to Bsq

Another way of playing would be B × P followed by Kt to B3, Ksq, and B2. The following would have formed a neat catch:—

52. B × P, P to R4. 53. B to B6, P to R5, and wins.

52. — P to R4
53. K to Ksq — P to R5
54. K to Qsq — Kt to K5
55. K to B2 — P to R6

I was in no hurry to take off the KtP, as I could not afford to let White take my two P's and have two united passed Pawns. I was playing to get the QBP.

56. B × P — Kt to Q7!

the adventurous and bold Knight

57. B to B6 — B to R3
58. Kt to B3 — P to R7
59. K to Kt2 — Kt to Kt8
60. K × P — Kt × P (ch)
61. K to Kt2 — Kt to K7
62. B to K4

This is weaker than P to K5, which I believe might have been done before. Kt × KtP

63. B to B2 — Kt to K7
64. P to B5 — P × P
65. B × P — P to B6 (ch)

I fondly hoped White would play K to B2, in which case B to Kt2 would win a piece.

66. K to Kt sq. — B to Kt2
67. Kt to Kt5 — P to R3
68. Kt to R3

White could also play 68. Kt to K6(ch), K to B3. 69. B to Q3.

68. — Kt × P
69. B to Q3

It is White's intention to draw the game by playing Kt to B2 and K4. To prevent this I made a last effort.

69. — K to B 3
70. Kt to B2 — K to K4!

I ran every possible risk in this game in the vain effort to avoid a draw.

71. Kt to Kt4 (ch). — K to B5.
72. Kt × P. — (See Diagram No. 4.)

I now played B to Q4, with the idea of going to K3, whereupon

White played the ingenious move of 73. Kt to B5, and the game was drawn, as I cannot save the P. I am, however, not quite satisfied whether the game is really a draw, although I believe so. Black, however, could continue with either B to Bsq., or K to K6, or B to K5. These lines of play lead to some interesting variations, which I must leave you to examine for yourself.

Our Whist Column.

ON DISCARDING.

By Mogul.

THE essential principle of discarding, viz.—to discard the card least likely to be of use,—is so palpable that I can only wonder that in these latter days an attempt should have been made to ignore it altogether and propose therefore to consider the play which necessarily follows from an adherence to this principle and to comment on that which has been suggested in total disregard of it.

It requires but little experience to know that cards which may be of use if we hold the long trumps or even a certain card of re-entry, may be of no use at all under other circumstances, whilst other cards may be of little value if we hold winning trumps, but of great value if we are weak; hence arose the general rule given in Mathews (whose treatise still is, after Clay's, the most improving book on Whist for the advanced player) as follows: "If weak in trumps, keep guard on your adversaries' suits; if strong, throw away from them, and discard as much as possible from your partner's strong suit in either case." Now this is a good general rule, but, like other general rules, is too short to embrace all cases, and, in fact, there are so many contingencies affecting the discard that I doubt whether any sufficiently general reliable rule can be framed, and my advice to players is to keep the principle above stated ever before them and apply it in each case to the best of their judgment. If the strength of trumps is clearly on a player's side and he has a good strong suit, he will, of course, discard from his weak suit; but if the strength of trumps is clearly against him and his main object is to save the game, he will, equally of course, protect his weak suits, such as King or Queen and one or two others, and Knave, or even Ten, with three others, by discarding from his other suit, however strong or weak it may be. The chief difficulties in discarding arise when the strength of trumps on either side is not pronounced or when successive discards have to be made, and either weak suits must be unguarded or winning cards thrown away. In all these cases every player must rely on his own judgment. Having regard to the score, &c., sometimes a winning card must be retained to prevent the adversaries making others in the suit. Sometimes it must be discarded in order to keep guards on other cards; sometimes a losing card must be retained to lead to your partner holding the best and others or to put the lead in the hand of an adversary (this only in emergencies), and so on; in fact, the reasons *pro* and *con* for certain discards are often so well balanced as to make the proper discard in such cases as puzzling a matter as any in Whist.

With these views I regard Cavendish's dictum in his treatise, "When trumps are declared against you, your partner will give you credit for strength in the suit from which you originally threw away," as terribly misleading, and so does every fine player whom I have yet consulted. It assumes, in the first place, that you have a strong suit from which to discard, a most dangerous assumption to make when the game is in danger, and one very likely to destroy the only chance of saving the game, for because on the assumption that you are strong in the suit your partner would be justified in leading King or Queen, holding with it one or two small ones; and, if you are not strong, will sacrifice his honour uselessly; or, should he be induced by your discard to open a suit in which he holds nothing, the chances against your holding two honours are so considerable that, in all probability, the lead will suit the adversaries more than yourself. The dictum further assumes that you invariably want to be led to in the suit discarded from, but this very frequently will not be the case; *e.g.*, one of the safest and best discards when you want to save the game is from an Ace and two or three small ones, and yet you would much object to having the Ace taken out of your hand unless your partner has strength in the suit. Take a case. When you hold Knave, Ten, and two others of one suit, and Ace and two small ones of another, the strength in trumps being with the adversaries and the game in danger, the proper discard is from the Ace suit; but the most advantageous lead for your partner to make, so far as your own hand is concerned, is the other suit; or, perhaps, holding Queen and two small ones in one suit, Knave and three small ones in another and two small cards in a third suit not yet opened, the proper discard is from the last. And yet it would be very awkward if your partner should jump to the conclusion that you wanted him to lead the suit. But Cavendish, with that love for rigid rules and uniform play which seems more and more to pervert his judgment, has lately pushed his views still further, and in his criticism on Proctor's treatise, "How to Play Whist?" has gone so far as to state, "that the discard from strong suits is as much a 'signal' as the call for trumps." His meaning here is certainly not very clear, for how, unless the Ace be discarded, his partner is to tell that it is a discard from a strong suit he does not explain; but, having regard to his above-quoted dictum, I suppose he means, and can only mean, a discard when the strength of trumps is adverse, and that such a discard is a command to his partner to lead that suit, and yet how foolish such a signal would be! For only consider that a discard is *always* forced play. We cannot refuse to make one merely because we have no strong suit. No one is ever obliged to make any other signal, but a player is compelled to discard, whatever his cards may be, and thus, according to Cavendish, to command his partner to lead the suit discarded from; but when one considers the innumerable hands that may be held in which we would prefer our partner not to lead the suit discarded from, and yet dare not discard from the suit we would like him to lead, as doing so would uncover the only card we could hope to make in it, does not Cavendish's theory appear thoroughly suicidal? It certainly does so to me, and all the more so when I reflect that when the adversaries have the strength in trumps they, and not your partner, will generally have the lead after your discard and will certainly avoid leading either of the suits which, if the discard be a signal, you or your partner have shown by your discards that you want led. Cavendish's signal would therefore guide your adversaries into the winning path and be worse than suicidal, inasmuch as your partner would suffer with yourself.

It would seem to me, and in this view I am supported by all the fine players with whom I have discussed the point, that you cannot regard a partner's discard, when trumps are adverse, as expressing any wish, much less any command, that you should lead that suit, and that you are bound, in the absence of any other indication than the discard of a small card (for if Ace be discarded it is quite another thing), to lead the suit which suits your own hand best—*e.g.*, to lead from a suit of four with two honours or any stronger suit, or even from a suit headed with Knave or Ten, rather than open a suit in which you hold absolutely nothing; but, if you have no suit you can open without palpable disadvantage, you had better, in such an emergency, lead the suit from which your partner has discarded, not because he has told you he is strong in it or has shown he wants it led; but because, as a general rule, the suit, from which he can discard with the least risk, will be his strongest suit. In such a case, I would lead Knave, and probably Queen, holding with either, two small ones: but I most assuredly should not so far rely on my partner holding strength in the suit as to lead King from King and two small ones; or, indeed, with King and one other to open the suit at all.

CONTENTS OF NO. 1.

NOTICES.

KNOWLEDGE OCTOBER NUMBERS (205, 206, and 207) have not been included in any monthly part, but form part of Vol. VIII., the last number containing the index to the Volume. These three numbers can be obtained either through an agent or direct from the Publisher, price 3d each, post-free.

TERMS OF SUBSCRIPTION.

	s.	d.
To any address in the United Kingdom, the Continent, United States of America, and Canada ...	7	6

The cost of postage of a single copy to any address in Great Britain is three halfpence. The same amount also is sufficient for the Continent, the United States, and nearly all countries in the Postal Union.

All subscriptions are payable in advance.

KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART

LONDON: JANUARY 1, 1886.

THE UNKNOWABLE;

OR,

THE RELIGION OF SCIENCE.

By RICHARD A. PROCTOR.

THE BIRTH OF RELIGIOUS IMPRESSIONS.

ALTHOUGH we may assign a definite position, in the development of the religious ideas of a race, to some particular class of thoughts, it must not be forgotten that there has been no process of religious stratification. We cannot say even of any man that in such and such a part of his life ideas of one class prevailed, which gave place later to ideas of another class, and these in turn to other ideas, and so forth; for even where a man has seemed to pass by quick transition from one "religion" to another, the transition has not in reality been sudden. The views which seem new have been long present; it has been only by a mental struggle that the older views have been maintained; and all which has in reality been sudden (if aught has) has been the cessation of the long struggle by which the gradual encroachments of more advanced ideas had been resisted. If this is so in the case of a single mind, we may be assured that there has been proportionate slowness of development, which means a much longer and more complicated process of change, in the religious ideas of races. We cannot truly say of any race,—at this part of its history the people believed thus, but at such and such a time they adopted this or that new belief. At every stage of the progress from the infancy of the race to such development as it may have attained, different forms of belief have co-existed, even where an outward uniformity may have been maintained.

It will not be idle, indeed, to digress here for a moment in order to consider the kindred lesson taught by the study of other subjects than that with which we are here dealing. In many departments of inquiry, perhaps in all, the mistake of imagining an undue uniformity and simplicity of arrangement has been made, and has seriously affected the progress of research. The earlier astronomers pictured a solar system of so many similar planets,—a galaxy of uniformly distributed stars; the geologist clothed the earth with a series of layers like the skins of an onion; the biologist of old times pictured races of animals as severally descended from single pairs; the historian imagined each people descended (as the biologist had imagined the whole race of man descended) from a single pair; the chemist had his four elements out of which all things were formed: throughout the whole range of what may be called the science of earlier times we find the underlying idea that the phenomena of science, history, sociology, and religion, are uniform, and the associated problems simple.

With all the progress of modern inquiry we find the old leaven apparent. In all departments of science, the less philosophic and thoughtful—who are altogether the more numerous—fall constantly into the mistake of overlooking the diversity and complexity of the processes which are taking place throughout the universe. In astronomy men pretend to say thus and thus did the processes succeed each other by which the solar system, or this or that part of the solar system, were formed,—when doubtless not only those processes of which the evident traces remain, but multitudes of others of which we have no evidence and no conception even, have taken place in varying degree at all times in the system, and are taking place now. Consider geology again,—How neatly the various eras of the earth's history are separated in the mind of the ordinary student of geology; how complacently he distinguishes the Eocene, Miocene, Pliocene, and other such periods (precisely as if all were actually seen) from each other, as though at one time the whole earth were clothed in one set of garments, at another in an entirely distinct set, and at another in a set altogether changed yet once more.

Or take a specific part of geological study, the formation of mountain ranges, which illustrates well the subject of religious evolution,—for we may aptly compare man's religious ideas, inherited or developed, newly formed or old and well worn, with the various forms of the earth's surface-contour:—

Even now, when geologists have learned to trace the actual processes by which a mountain range is formed, too many students of geology have entirely erroneous (because too simple) ideas of the way in which the mountain range reached its actual condition. They picture to themselves the various stages, when first the crust yielded and molten matter was extruded, then next the region thus broken and loaded sank gradually beneath the sea and became a vast trough along which matter was deposited, and after this trough had in the course of ages been filled (steadily sinking all the time to depths of many miles) the process was reversed and the great seam thus formed was gradually squeezed upwards by the side pressures of the yielding sea-floors around it, while lastly the action of denuding forces carved out of the upraised mass the peaks and pinnacles of the present mountain range. All this is right enough. Of all these processes we have in the Alps and Apennines, the Himalayas and the Rocky Mountains, very clear and decisive evidence. But the processes were not neatly defined and separated as the student is apt to imagine. The process of extrusion, for instance, did not cease when the process of sinking began, but went on still, at various places along the original region of yielding. Again the process of sinking with deposition was not uniform, nor did it give place everywhere to a process of uprising: both processes were going on, intermittently and irregularly, at the same time, while all the time the extrusion of matter was taking place, though now in new regions. Yet once more, sub-aërial denudation did not wait till the upheaval had been completed before it began its work, but went on in company with the process of upheaval, with the process of sinking, and even with the process of extrusion, all these processes acting with ever varying degrees of energy and efficiency, and often intermitting their action.

If a purely physical problem presents such complexity, even where the records of every part of the work are more or less clearly legible in the earth's crust, we may be well assured that the problem of religious evolution

in any race of men is not to be solved by supposing that such and such religious ideas were successively formed, and successively displaced their predecessors. Probably there was never a race of men, however limited in mental activity, or wanting in originality, which held even for a single generation kindred ideas about religion. As certainly as among the savage inhabitants of a small island of Polynesia we find diversities of size, figure, complexion, strength, activity, intelligence, and the like, so, could the ideas of the tribe about matters religious be ascertained, it would be found that no two have thought precisely or even nearly alike. It is easy to imagine that they all have similar ideas, because only a few among them can be got to speak about their religious notions and even these few in answering the questions of a stranger can give but vague ideas of what they themselves believe and suppose to be the ideas of their fellows. If a member of some strange new race came among a community of Christians as found in some small European or American town, and speaking their language imperfectly were to ask the first nine or ten of them to define their religious belief, it is very likely that, even among a community with creeds and catechisms to define religion, he would obtain answers indicating a considerable diversity of opinion,—whether the persons questioned tried carefully to express their real thoughts, or as carefully tried to avoid any exact expression of opinion. It would be curious to inquire what such a stranger would be apt to infer respecting the Christian religion if he pursued his inquiry very carefully and earnestly. Probably if the experiment could be tried it would dispose us to adopt with considerable caution the accounts which have been collected of the various forms of belief entertained by savage races. Assuredly it would show that if among the members of a small community of Christians there is a marked diversity of views, there must be more marked diversity still among savage communities; and that therefore there can have been no such uniform development of religious ideas even in a single human race as some students of religious evolution appear to imagine. Still less can we imagine that in every race of men, there was the same succession of religious strata, —so to describe general ideas about matters religious as distinguished from definite religious dogmas.

I imagine then that while we must regard the general impression produced by natural objects, forces, and processes, as the embryonic form of the religious sentiment, individuality being ascribed to everything which influenced the life of the savage man, this impression was experienced in very different degrees by different races and by different members of the same race. How far back we may trace the beginning of this idea it were difficult to say; but it must have been present long before pastoral or agricultural pursuits began: it must have belonged to the time when our altogether wild ancestors, forest-haunting or cave-inhabiting, first became conscious of their constant contest with the forces of nature, with other animals, with their fellow men. We may even when we see our remote kinsmen the Gibbons welcoming the rising of the sun with noisy gesticulations, conceive that even in those mere animals the germ of the thought is present that the sun is a warm personal friend—a thought certainly adopted by many of the lowest races of savages, though it required many thousands of years of culture to develope it into a definite solar religion.

And if the vague idea of personality in natural objects or forces was diversely distinct in different minds even among small communities of child-men, how still more diverse must have been the way in which the idea eventually became developed that this personality was human and that the power and volition conceived to be present in sun moon and stars, in cloud and storm, in mountain and river, in trees and animals, were derived from men who had once lived upon the earth. Mr. Spencer's ghost theory is comparatively simple so far as it relates to the development of ancestor-worship as such; but manifestly we can only accept it in a very complex form as related to the development of nature-worship. Not only would different races of men, it may be presumed, form very different ideas of the way in which the spirits of the dead animated objects of different orders, from some small animal to the sun in his glory and the moon walking in light, but among the members of one and the same tribe there must originally have been great diversity of views on a subject such as this. We must remember that whatever ideas we may now find prevalent in a tribe of savages must have been initiated by individuals, and were probably only known to such individual thinkers for many generations. The hunter who was led by the varying fortunes of the chase to attribute good or evil influences to particular natural objects or phenomena, and so to conceive the idea that they possessed a personal individuality akin to his own, would probably keep the idea to himself—either because it would not be worth his while to do otherwise, or because it might seem well worth his while to keep such special knowledge of his to himself. And so with men who lived otherwise than by hunting. In many generations such ideas would be entertained, in very diverse forms, by individuals, before they began to be common property. But if this were so with that early and comparatively general notion, much more would it be apt to be the case when some among the members of a race began to attribute human personality to natural objects or phenomena.

The recognition of a second self, a soul or spirit, suggested by the phenomena of dreams, trances, catalepsy, and so forth, probably began earlier, and was more generally and uniformly diffused. For here specific phenomena, alike among all races of men, and not very different even among different individuals, were in question,—while the same phenomena were witnessed by many, were talked over by those who had witnessed them, and became in fact after a fashion matters of scientific inquiry. I imagine that among ninety-nine races out of a hundred and among nine men out of ten in any race,* the idea would be adopted that every man has a second self, which may leave him when he sleeps or becomes insensible, returning and reanimating his body when he comes to himself: (the very words now so familiarly used imply the old doctrine in its old form). One can see also that in the great majority of cases (that is among nearly all races, and among most of the individuals

* We find, however, that even these natural thoughts, not necessarily connected with religion at all, and likely, it would seem, to occur to nearly every one, are not entertained by all even among fairly developed races. I do not mean that they are rejected as the man of science of to-day rejects them, because of the scientific interpretation which shows the idea of a second self to be unnecessary and inexact, but that they have not presented themselves at all or have seemed inconceivable if suggested. Thus, Sir S. Baker asked Commoro a Latooki chief whether he did not know that he had "a spirit in him more than flesh. Do you not dream and wander in thought to distant places in your sleep? Nevertheless your body rests in one spot. How do you account for this?" to which Commoro who here and in the whole conversation showed much more acumen than his questioner, replied, laughing, that it was a thing he could not understand. "It occurs to me every night. How do *you* account for it?" (Observe that Baker had tried to account for it by an explanation which Commoro's better sense rejected—viz., by the idea that a spirit in him wandered to distant places during sleep.)

of each race) the idea would be entertained that the breath represented, or actually was, this second self; for in sleep the breathing is scarce perceptible. Thus the second self would be regarded as a spirit or breath, and death would come to be regarded quite generally as merely the prolonged, perhaps final, departure of the spirit or breath from the other or bodily self. In passing, too, we note that as the proper second self could pass away and return to its companion body, so on occasion other spirits good or bad might make that body their temporary home, giving in one case "inspiration" in a good sense (very definitely believed, I imagine, in old times to be what its names implies, an in-breathing) and in the other "possession" in an evil sense.

These ideas would prevail long before any idea of associating religious sentiments with them would be entertained, and still longer before the thought of assigning what had been human spirits to natural objects or powers would suggest itself even to the mere imagination.

PLEASANT HOURS WITH A MICROSCOPE.

By HENRY J. SLACK, F.G.S., F.R.M.S.

AMONGST the insects injurious to man, aphides occupy a prominent place, and no species are worse than the Cotton Bugs, or American Blights. A visit to an orchard assailed by these creatures presents a curious aspect, the branches and twigs glistening with white, cottony-looking threads. Under this cover lie multitudes of the insects. The slightest touch of the finger squashes scores of them, and makes a nasty brown stain. A hand-magnifier discloses the family parties. Young and old are seen all higgledy-piggledy together in what might be supposed a wretched condition of over-crowding, but they are quite happy in their way.

The microscopist should cut off some portions of the afflicted twigs, and keep them for a few days in a box with a glass lid. This allows their rapid multiplication to be noticed; but as the sap dries up, the bigger ones soon die. The cottony stuff hinders observations of any details, but it may be got rid of quickly by immersing the insects in a drop of alcohol, and stroking them very gently with a fine needle or a bristle. The older ones are so swollen out with the tree sap that a slight touch bursts them, and it is then common to find a number of young ones escaping, some in a very forward condition, others in an embryonic state. The adult viviparous females have their bodies longer than their rostra, but the little ones have their rostra considerably longer than their bodies. The very early development of the sucking and piercing mouth-organs is a striking fact in the life history of these creatures. The rostra look quite out of proportion to the rest of the new-comers, but it enables them to practise their voracity with the least possible delay. In the adults, as well as in the young, the piercing organs, consisting of three fine tubular, sharp-pointed bristles, are of great length — much longer than the bodies of the full-grown creatures. This allows them to swarm in clusters, one atop of another, and all sucking away together. The young ones can move actively, but they do not leave the family party in which they are born until the numbers render emigration indispensable, and then they usually settle close to the old group, and do nothing but fill themselves with the plant-juices and bring forth more young. The antennæ are small, and the two top joints provided with curious depressions, surrounded with hairs, much like that shown in the sketch of the antennæ of the phylloxera in KNOWLEDGE, August 28. (See Fig. 2.)

The belief that antennæ may be organs of hearing is strengthened by the occurrence of such formations. They are hollow, with drum-like membranes stretched over the bottom, and may be sensitive to very slight sound-waves. Neither hearing nor seeing, however, could be of much use to a cotton bug. The eyes are very small, and probably little used, as the vast majority of the insects pass their lives huddled together where they are born, covered with the cotton, and those that migrate from the family heap, for the most part only move a quarter or half an inch further on the part of the plant that is attacked.

The founder of a cotton-bug family is a viviparous female, called a Queen aphis by Mr. Buckton. She is larger than the one figured from him in the sketch No. 1, and black. She is the product of an egg laid by an impregnated female in a crevice of apple-bark, and, acording to Buckton, she often dies before laying her egg, in which case her body serves as a protecting cover.

Fig. 1. Fig. 2. Fig. 3.

Fig. 1 shows one of her adult children, the little streamers being the cotton threads they exude. The young are produced at a rapid rate, so that long twigs are covered almost as soon as they are attacked, and only a sharp eye detects the presence of the enemy before the trees are infested with thousands, and conspicuously whitened with the cotton down. Cold does not readily disagree with these creatures. Mr. Buckton speaks of finding them plentiful when the thermometer stood at 21° F.; and the writer noticed the same thing on the 18th of November, when the night temperature on the grass fell to 24° F., and must have been a few degrees lower where the aphides were thriving in a bitter east wind. Violent rains are much more destructive, and after two or three days of downpour, several trees that had been thickly infested were washed quite clean. When the trees are small, like pyramids, bushes, &c., painting the affected parts with strong size is the best remedy; but this is impracticable with large old ones, and they perish under the attack. The rough knots that disfigure branches are caused by the irritation of these creatures, and some are said to assail the roots.

The rostrum, or snout, is of the same pattern as in other aphis species, but it is very stout and strong, and at the tip has stiff, rough hairs, as shown in Fig. 3. Pressure in mounting opened the gap wider than it is in nature. Some curious structures are found on the back of the insects. Near the antennæ they make pretty

rosettes, as shown in Fig. 4. Others are larger, of which a specimen is given in Fig. 5, taken from the tail end. Under a high power, minute, dot-like projections are seen, but I could detect no openings, and do not know what they are. Mr. Buckton does not mention them.

I have not been fortunate enough to see the cotton-down exuded, or to find the organs exuding it.

Putting some bits of twig covered with the creatures in a box with a glass lid facilitated watching them. They could not have obtained much nourishment, as the twigs soon dried up, but the young were produced in great numbers. Not one, however, put forth a particle of the cotton stuff.

Fig. 4. (× 320.) Fig. 5.

Like the rest of their tribe, they are difficult to dissect. The operation is facilitated by a little glycerine, and more can be done in a drop of methylated spirit than in plain water. The tracheal system is well developed, and some of the larger vessels are easily distinguished amongst the miscellaneous matter that comes out when a specimen is squeezed in a water drop. It is then easy to pick out some tracheæ with a mounted needle.

Besides the apple-tree plague, other species attack elms, dogwoods, &c., and, on the whole, they are among the worst of the insect plagues. America is credited with their origin, and hence they are often called "American Blight." Like other aphides, they chiefly multiply by viviparous broods. The males occur late in the season, and are not often seen. They are born with a rostrum, but Mr. Buckton observes, "the rostrum would seem to disappear at the subsequent moult. The sex is finally blind as well as mouthless." The oviparous female is also described as destitute of a sucking organ. The viviparous females occur in a winged form as well as in a wingless one, and Lichtenstein, cited by Buckton, says they swarm in September in the south of France.

The organisation of these creatures seems above the necessities of their way of life. As individuals they deteriorate as they pass from infancy to the adult stage. Any action of rudimentary intelligence ceases when they have fixed their mouths in a good place, and penetrated to the sap vessels. They have then nothing to do but suck and bring forth numbers of their kind.

The scientific name of the section of aphides to which the Cotton Bugs belong is Schizoneurinæ, from the Greek *schizo*, to cut, and *neuron*, a nerve. It refers to the furcations of the veins in the winged forms. The Cotton Bug of the apple is *Schizoneura lanigera* (wool-bearing). *S. ulmi* attacks the elm. *S. lanuginosa* forms gall-like masses at the ends of the twigs of *Ulmus campestris* and *U. suberosa*, which are densely hairy (Buckton). *S. corni* assails dog-wood.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By Edward Clodd.

III.—DISTRIBUTION OF MATTER IN SPACE.

MATTER, as explained in the foregoing section, is both visible and invisible, ponderable and imponderable. In its ponderable form it is distributed throughout space in bodies of varying densities; in its imponderable form as ether it fills the intervals between the particles composing those bodies, as also the vast intervals between the bodies themselves. The most important of these—as the sand by the seashore, innumerable — are the "fixed" stars, so called from having no apparent motion of their own, although, in reality travelling at enormous velocities. Each of these, unless it be an extinct, burnt-out sun, shines by its own light, and is probably the centre of a system of planets with their satellites or moons, and other bodies, as is our sun, which is itself a star. "One star differeth from another star in glory." Not, speaking broadly, in the stuff of which all are made, for the light thrown by the spectroscope on the chemistry of the heavenly bodies has revealed their general identity of structure. No matter how distant the star, so long as the light emitted is strong enough; broken on prisms, it reveals through its spectrum not only what elements are present in the glowing vapour, but even the direction of the star's motion, *i.e.*, whether it is receding from or approaching our system. The nearest fixed star is Alpha Centauri, the annual parallax of which (that is, the apparent change of position as seen from opposite points of the earth's orbit) is nearly one second of arc, giving a distance of twenty millions of millions of miles. Its light, travelling 186,000 miles per second of time, therefore, takes nearly three years and a half to reach us, and so vast is the interval that, viewed from this star, our solar system appears as only a point in space.

The differences between the stars are in their sizes, their brilliancy or magnitude, and their colours, this last giving some clue to their stage of development. For there are stars young, middle-aged, old and decrepid; and there are stars cold and dead, radiating no energy, and whose existence can be known only by their influence under the force of gravitation upon other bodies.

The astronomer has not arrived as yet at any certain conclusions regarding the general distribution of matter in space. But the combinations, as seen from our system, are as varied as they are complex. Besides double and multiple stars—their apparent nearness often being due to their lying in nearly the same straight line from our system—there are the constellations, many of the names of which are relics of that animistic stage in man's belief when everything was personified. There are star-clusters, light, cloudy-looking patches, made up of suns which, from our point of view, lie densely packed together in galaxies numberless as the bodies that compose them.

Besides the fixed stars and their systems, straggling in scattered groups on either side of the Milky Way or composing its cloud-like arch, there are the vast masses of glowing matter called, in contradistinction to the stellar nebulæ, which the telescope has resolved into stars, gaseous nebulæ. These are of regular and irregular form—circular, elliptical, spiral, and so forth; they are the raw stuff of which suns and systems are being formed. These nebulæ; the fixed stars; with whatever appertains to them, and the vagrant bodies known as comets, with their more or less associated meteor streams, comprise the ponderable matter of the universe. The sum-total of their radiant energy, save the small proportion intercepted by one from the other, is ever in course of transfer to the imponderable ethereal medium.

The results of modern research into the structure of the universe, in which inquiry Mr. Proctor has taken so distinguished and important a part, and who therefore speaks "as a man having authority and not as the scribes," is thus summed up by him in the article on "Astronomy," contributed to the last edition of the "Encyclopædia Britannica":—

> The sidereal system is altogether more complicated and more varied in structure than has hitherto been supposed; in the same region of the stellar depths co-exist stars of many orders of real magnitude; all the nebulæ, gaseous or stellar, planetary, ring-formed, elliptical and spiral, exist within the limits of the sidereal system; and, lastly, the whole system is *alive* with movements, the laws of which may one day be recognised, though at present they are too complex to be understood.

THE SOLAR SYSTEM AND ITS MEMBERS.

The Sun is by no means the biggest of the stars, and, as compared with them in brightness, he probably does not exceed the third or fourth magnitude. But he has the greatest interest and importance for us, seeing that to him are due those manifold energies by which the processes of nature, both chemical and vital, are carried on here and elsewhere. And, with the knowledge which has been gained during late years concerning the sameness of the stuff of which nebulæ, stars, and planets are spun, the nature and arrangement of the contents of our solar system may enable us to make lawful analogies concerning the contents of systems beyond it. The Solar System comprises: 1, the Sun; 2, the Planets, large, small, and minor; 3, Moons or Satellites; 4, Comets, together with meteors or shooting-stars.

The sun, whose volume exceeds several hundred times all the other members of his system combined, is the principal and indispensable source of ceaseless energy radiant as light, heat, and chemical action, to them. Of this energy the planets receive or intercept but the 230 millionth part, the earth receiving but the 2,170 millionth part, and even the larger proportion of this energy is ultimately radiated by them into space. The planets, one and all, revolve in nearly circular orbits, but on rather differently inclined planes, round the sun, in virtue of that energy of orbital motion with which each was endowed at birth, and which counteracts the opposing force of his gravitation, which would otherwise pull them into him, absorbing them in his mass. Including the swarm of minor planets or asteroids, of which new ones are being frequently discovered, they are perhaps to be numbered by thousands, and are of various sizes and densities, and in different stages of progress and decay. The evidence for the primitive gaseous state of all bodies now possessing greater density will be given hereafter, but our system itself supplies illustration of the passage of planets and satellites to an increasingly solid form. Some, like our Earth and Mars, have cooled down sufficiently to be covered by a solid crust, and to be fit abode for living creatures; others, like Jupiter and correspondingly huge bodies, are still in a more or less heated and partly self-luminous condition. The smaller bodies have long been cold and inert, like our airless, barren moon. In her pale, reflected light and scarred surface, illumined no longer by flame of central fires, we learn that what she is, planets and the sun himself will one day become.

The moons revolve round their several planets under similar restraint of force and freedom of energy as the planets themselves. The gaseous masses composing comets and meteor-streams travel in very eccentric orbits. In fine, motion is everywhere, in ether, atom, molecule, and mass; the sun, like his fellow stars, has his proper motion, carrying with him planets, satellites, and whatever other bodies are within the curb of that force of his gravitation which is itself obedient to the attraction of bodies perchance as much exceeding his own in power as he exceeds the mote dancing in his beams.

THE EARTH.

The mass of matter called the earth is of nearly spherical shape, being slightly flattened at the poles and bulged towards the equator.

It consists of a core enclosed within, and connected with, a cool, solid crust, three-fourths of which is covered by a layer of water, and the whole surrounded by an atmosphere.

The entire mass, solid, liquid, and gaseous, spins on its axis at the rate of about 1,000 miles every hour, and speeds through space in its orbit round the sun at the rate of 1,000 miles every minute.

The atmosphere is composed, in the main, of the uncombined elements oxygen and nitrogen; the water is chiefly compounded of combined but mobile oxygen and hydrogen. Of every hundred parts of the crust, ninety-nine are made up of about sixteen out of the seventy elementary substances, and of these sixteen the larger number exist in small proportion. It is computed that fully one-half of the crust consists of oxygen which it has taken into itself from the atmosphere, and that already one-third of the water of the ocean has been absorbed by minerals. These are matters to be remembered when dealing with the energies which have modified the structure and composition of the framework of the earth. The average density is about five times and a-half that of a globe of the same size made of pure water, but the large extent covered by the ocean in the southern hemisphere, whither the tendency to collect was probably manifest at the outset when the steamy vapours condensed and filled the depressions in the crust, point to an excess of solid matter in that direction.

What the inside of the earth is like no man can tell. But it is probably solid throughout, and in a state of intense heat at no very great depth, as manifest in volcanic outbursts and allied phenomena. These show that the earth has not yet lost the whole of the original store of energy which it acquired during the aggregation of the particles of which it is built up in their passage from a diffused nebulous state to one of increasing densities under the action of the force of gravitation. But the escape of that energy through the crust to the ethereal medium is unintermittent, and its final dissipation into space is therefore only a question of time.

The crust was probably never uniformly smooth, because the contraction of the interior mass as it cooled would bring about a state of tension causing shrinkage of the surface. Hence would be the beginnings of those

wrinkled, and cracked, and crumpled features which other agencies would score more deeply in the face of the globe, but which bestowed thereby a beauty and variety in valley, mountain, and table-land that no even surface could boast.

Our knowledge of this crust extends to only a relatively small depth, the aggregate thickness of the strata or layers of rock already measured being about twenty-five miles, or the one hundred and sixtieth part of the earth's semi-diameter. The term "rock" is applied alike to hard granite and loose sand, to ore veined with metal, and to mud from country lanes, as including the materials comprising the crust or shell. Rocks are divided into two classes—unstratified and stratified. The *unstratified*, which are also called igneous or Plutonic, embrace all rocks which, as they now exist, have been fused together by heat, or erupted from the earth's interior by volcanic agency. The *stratified*, which are also called aqueous or Neptunic, embrace all rocks which have been deposited as sediment by the action of water or air, or which are due to the growth and decay of plants and animals. With this class are grouped the *metamorphic*, stratified rocks which have been metamorphosed into a crystalline state by the action of heat and pressure, resulting in effacement of their original character. Throughout the entire series of rocks the newer have been, and are being, formed out of the older, which, unless upheaved, are always found at the bottom; but of the original crust not a trace remains.

The depths to which the unstratified rocks extend is unknown, and as they contain no organic remains whatever, they tell us nothing concerning the origin and successions of life on the earth. Their place in the continuity of geological history will appear as we advance; meanwhile we may pass to brief glance at that section of the calendar which deals with the stratified groups. For convenience sake, and not as implying any gaps between their several formations, save where natural causes have operated, they are divided into five epochs. These, together with the typical remains of plant and animal associated with each, are shown in the following table:—

Epoch.	*Thickness of strata.*	*Plant.*	*Animal.*
Archeolithic or Eozoic (*i.e., dawn-life*), chiefly Metamorphic ...	70,000 ft.	Algæ*	Monera.*
Primary or Palæozoic (*ancient life*)	42,000	Ferns	Fishes.
Secondary or Mesozoic (*middle life*)	15,000	Pine-forests	Reptiles.
Tertiary or Cainozoic (*recent life*)	3,000	Leaf-bearing forests	Mammals.
Quaternary or Post Tertiary......	...	Existing species.	

* Both marine.

COAL.

By W. Mattieu Williams.

CANNEL COAL AND BOGHEAD.

CANNEL coal or "candle coal," so named because some varieties are so highly bituminous that a tapered piece may be lighted at its angle and will continue for awhile to burn like a candle, differs mechanically from ordinary bituminous coal in being harder and far more compact and homogeneous in structure. One result of this is that it may be freely handled without soiling the fingers. Some varieties of cannel coal resemble anthracite at first sight and handling, but an expert can easily distinguish them. Anthracite is more lustrous than cannel. Whitby jet is a sort of cannel.

One peculiar character of the cannels that are the richest in flaming constituents is the "streak." Although the coal itself is black, whether the fracture be new or old, if it be scratched with the point of a knife the streak thus made is brown. The value of a sample for gas-making may be roughly tested thus—the lighter the streak the richer the coal.

Some cannels have a fracture which is quite smooth and uniform, and slightly concave or conchoidal; others are curiously different. They appear to be made up of an agglomeration of circular constituents, like wood knots, and accordingly receive the name of "curly cannel." The celebrated Wigan cannel is somewhat curly, but the most characteristic display of this curious structure is afforded by the Flintshire curly cannel, found in the neighbourhood of Leeswood and Coed Talon, near Mold. In many of the cottages of the thrifty colliers of that neighbourhood a lump of this, carefully black-leaded to display the curls, may be seen displayed in the best Sunday room as a mantelpiece ornament.

In this Leeswood seam the curly and the smooth cannel lie in direct contact; first about 2 feet of smooth cannel, below this about 18 inches of curly cannel, and at the bottom of the curly 15 to 18 inches of bituminous shale. The roof shale overlying the smooth cannel is black, but only slightly bituminous. The fact that has puzzled me in studying this deposit is the absence of any gradation between the smooth and the curly; the transition from one to the other is curiously sharp, although they differ not only in structure and appearance, but also in composition, the curly cannel being much richer in gas-yielding constituents than the smooth in the proportion of about three to two (Dr. Andrew Fyfe's figures are 14,280 feet of gas per ton of curly, and 9,972 per ton of smooth. Wigan cannel 12,010).

The cannel coals generally yield a larger quantity of gas than ordinary bituminous coal. Both vary greatly in this respect, as the above figures show, but taking a rough average, the quantity may be stated as about four to three in comparing cannels with good gas coal.

But the value of cannel in making gas for illuminating purposes must not be measured merely by this. Comparing equal quantities, the value of the cannel gas burnt in ordinary manner is far greater than that of gas made from ordinary coal. There are good chemical reasons for this, which I will endeavour to explain.

The gas in both cases is a hydro-carbon; but there are hydro-carbons and hydro-carbons, *i.e.*, compounds of carbon and hydrogen, in which the elements exist in varying proportions. For illuminating purposes we may have too much carbon or too much hydrogen. In the first case, the flame is lurid and smoky, unless special devices are employed for supplying an excess of oxygen or of heated air. In the second case, the flame is deficient in luminosity, is bluish and feeble, approaching to that of an alcohol spirit lamp.

There is a series of hydro-carbons which are technically described as having a composition of $C_nH_{2n\times2}$, and another series whose composition is represented by C_nH_{2n-6}. Those accustomed to chemical formulas will at once perceive that the first of these all contain a larger proportion of hydrogen than the second, that whatever figure is represented by $_n$, the number of equivalents of carbon in the first must always fall below those of the hydrogen, while in the second they must equal or exceed it.

The first is the Marsh-gas, or paraffin series of hydro-

carbons, the most volatile or gaseous and least complex of which is Methane, CH_4; the second is the Benzine series starting in like manner from benzine, C_6H_6. Having promised at the outset not to mystify the non-technical reader by an unintelligible display of my own technical erudition—(a proceeding as easy as grinding a barrel-organ when one has a text-book at hand), I will simply add that the various distallates from cannel,—whether they be gaseous at ordinary temperatures; or volatile liquids like the miscalled "benzoline" used in sponge-lamps; or less volatile liquids such as common paraffin oil and lubricating oil; or solids like the material of paraffin candles—all contain fewer equivalents or atoms of carbon than of hydrogen, and all of those similarly obtained by the distillation of ordinary bituminous coal contain equal or excessive equivalents of carbon. In consequence of this the paraffin or cannel series burns with a whiter, more luminous, and less smoky flame under ordinary conditions than the series from ordinary coal. Cannel gas properly made and burnt in a suitable burner has about double the illuminating power of ordinary coal gas.

The superior value of cannel gas is shown by the following figures, which I take from Clegg's "Treatise on Coal Gas." A cubic foot of gas from Newcastle Coking Coal (Pelton Main) burnt in a small batswing burner gave an amount of light equal to 232 grains of sperm, with an Argand burner 311. Newcastle cannel gas gave an average of 606. This double value is of great importance to the consumer, as the heat and the mischievous products of combustion are foot for foot about equal in both cases. With unmixed cannel gas, one burner gives as much light as two of ordinary gas. Corporations that are sufficiently civilized to make their own gas, give the benefit of this to the consumer: but we poor company-ridden cockneys are supplied with gas as bad as the Act of Parliament permits, and thus have to burn a larger quantity and pay our tyrants accordingly.

At the time when I commenced distilling coal and shale, it was generally stated on the authority of Reichenbach, that the production of the paraffin series depended on the low temperature of distillation. The claim in Young's patent was based upon this assumption, and the celebrated case of Young & Fernie was decided accordingly. I soon discovered, however, and others similarly engaged did the same, that this was quite wrong; that whatever be the temperature of distillation in either case, each kind of coal produced its own distinct hydro-carbon series: that by no mere variation of temperature could bituminous coal be made to yield the marsh gas or paraffin series, nor by any such variation could the cannel coal, or the black shale associated with it, be made to yield the benzine series or napthalene. Variations of temperature affected the specific gravity and volatility of the products—*i.e.*, the proportions of the different members of the series, but did not convert one series into the other. I state this with especial emphasis, because it is still but doubtfully understood by laboratory chemists, though clear enough to gas-makers and shale-distillers; and further and more particularly because it has an important and unrecognised bearing upon the whole theory of the formation of coal.

The theoretical question it raises is this. Does the existing vegetable kingdom present us with any great class or classes of plants that yield upon distillation a hydro-carbon series corresponding to that obtained from cannel coal; and is there any other class or classes that yield a series similar to that obtained from ordinary bituminous coal? If so, we are justified in referring their origin to such classes respectively.

Everybody knows that the tar used by sailors has a near physical resemblance to ordinary coal-tar, and that it burns with a similar smoky flame: the chemist recognises a similar close resemblance, though not an absolute identity. The tar and pitch used on board ship are obtained by distilling coniferous plants, pines, larches, firs, &c. Turpentine and resin are also obtained. Turpentine, resin, "Stockholm tar," and pitch are a family series, varying in boiling-points or volatility. They differ only slightly in their chemical composition from the series obtained from similar distillation of ordinary bituminous coal, and this difference is just such as exposure to oxidation, or, more especially, to the action of water, will effect.

My chemical readers will understand the force of this when I remind them of the fact that terebenthene, $C_{10}H_{16}$, the type of the turpentine and resin series, is readily converted by the action of bromine and iodine into cymene, $C_{10}H_{14}$, a typical member of the benzene or coal-tar series, and that similar acids are obtained by the oxidation of both series.

The camphors distilled from laurels and the naphthas from most of our forest trees have a similar close resemblance to the coal-tar series, but they all stand apart and keep apart from the marsh-gas, or paraffin series, obtained by the distillation of cannel.

Does any existing vegetation produce this last-named series? I am able to reply to this question, having distilled compressed peat in substantial quantities (one sample amounted to twenty tons), in the same retorts as were used for cannel. Excepting that the proportion of ammonia was much greater from the peat and the hydro-carbons very scanty, the results were the same; the hydro-carbons were distinctly of the paraffin series, and, when refined, were undistinguishable from the cannel products. In the crude state, their aroma was somewhat different.

Peat is made up of defunct mosses, cryptogamous or non-flowering plants. Here, then, we have a clearly defined and rather broad distinction. I am not prepared to assert that all the cryptogamia will yield the same results on distillation, my experiments on other members of this great subdivision of the vegetable kingdom being too limited for this: but they go far enough to justify further investigation.

The evidence supplied by the marsh gas itself points in the same direction. The vegetation of marshes is chiefly cryptogamic, and the gas is due to a slow distillation of the remains of such vegetation.

These facts obviously suggest the hypothesis that cannel deposits are ancient and fossilised peat bogs, while ordinary bituminous coal is the material of ancient forests. The idea that coal seams generally are ancient peat bogs much consolidated by pressure is an old one that has been much discussed, but the above-stated chemical facts indicate pretty clearly that we must be cautious in accepting any sweeping generalisation that applies alike to the formation of all coal. We must remember that both cannel and ordinary coal are found in the same coal-fields, though usually separated by mineral strata. The chemical differences, therefore, cannot be due to differences of pressure or subterranean temperature. *A specifically different material must have been originally deposited.*

Intimately associated with cannel are the bituminous shales. All that I am acquainted with yield the same products as cannel on distillation. There may be some

exception to this, but I have not yet heard of any. So intimately are they connected that the most remarkable example is frequently described as "Boghead Cannel," and a great lawsuit (Gillespie *v.* Russell) was fiercely fought in Edinburgh to determine whether it is coal or not coal. The landlord of Torbane Hill (Gillespie) granted a lease of all the coal on the estate to be worked by Russell. The mineral in question proved to be of far greater value than ordinary coal, on account of its yielding the paraffin series on distillation. At this date (1853) the Americans had not "struck ile," and the paraffin oil now selling at about 9d. per gallon in this country, was worth 3s. 6d. per gallon here, and even more in America. The Torbane Hill mineral was exported to the United States for the distillation of Kerosine there. Russell was consequently making a magnificent income, which excited the cupidity of his landlord, who denied that the lease gave a right to work this mineral, on the ground that it is not coal, and he proceeded accordingly.

I was living in Edinburgh at the time, and followed the proceedings with much interest. Geologists, chemists, microscopists, &c., were imported from all parts of Europe by both litigants, one set to swear that it was coal, the other to swear the opposite. I was then younger and greener than I am at present, and had a correspondingly profound respect for such titular appendages as F.R.S., &c., than I now have. My simple-minded faith received a painful shock on noting that all the distinguished fellows, graduates, and even professors who were subpœnaed (and paid) by Gillespie, found that the mineral in question was not coal, and all engaged in like manner by Russell discovered, on purely scientific grounds, that it was coal.

The best hotels of the city were filled with these distinguished men, and Edinburgh was in quite a britishassociationish state of scientific gala. Preparations were made, reports, proofs, and briefs were prepared, and all were ready for the fight; none more eager than the scientific combatants. Suddenly all the scientific edifice, or rather two edifices, collapsed like houses of cards. The judge set aside the learned gentlemen, and called for the evidence of colliers and coal merchants, who proved that when the lease was granted the mineral in question was known to exist, and vulgarly bore the name of coal—was worked and bought and sold as coal. Such being the case, the judge ruled that it was included in the contract, and the jury found accordingly for the defendant. The question was purely commercial, and was justly decided on commercial grounds. I need scarcely add that I heartily agree with the decision, though, as I shall show in my next, the Boghead mineral belongs to the class of bituminous shales, which differ widely from true coal.

A FUTURE FOR THE ENGLISH FARMER.—Let the farmers of England once realise the fact that they can make better cheese and butter and rear finer cattle than any country under the sun, and that they can not only supply all England with these commodities, but they can be very formidable rivals in foreign markets. Have not the Americans themselves paid prices for single English cows that would purchase a first-class farm and build model farm-buildings! Let farmers only reflect upon the enormous wealth that lies at their doors, and wake up to modern systems, and not be above learning. The Americans, wise in their generation, have from time to time sent over agents to England to inquire into the best modes of procedure, and they have improved their dairies in accordance with any excellence they may have seen in the old country. But let farmers learn from them, and not stand still: and if they take to heart some of the lessons they may gather from the various agricultural reports made by men of high credit, they will see that their case is a hopeful one. —*English Illustrated Magazine.*

OUR GALAXY.

LETTER TO SIR J. HERSCHEL.*

By RICHARD A. PROCTOR.

London, Aug. 8, 1869.

I SHOULD have written sooner to thank you for your very kind and encouraging letter, but for great pressure on my time. I wish also to mention, when writing, certain points I had accidentally omitted from my former letter.

You are not to suppose that I write now to meet the objections you have mentioned against my notions respecting the Milky Way, though I may have occasion to do so as I proceed. I do not wish to regard my views as something to be defended. I should have studied your writings and example to little purpose if I took this line. I may not hope, perhaps, to attain easily that placidity with which you are able to urge or to consider objections *against* hypotheses whose strong points you had shortly before exhibited; but I have at any rate definitely set that quality before me as the one which is of all others the most valuable to the searcher after truth.

First of the omitted facts is the discovery made by Lieut. Herschel that rich star-clusters sometimes show—besides the continuous spectrum—the bright-line spectrum of the gaseous nebulæ. This fact seems to me to be of the utmost importance. We find in it a fresh bond of union between all the members of the nebular family. Mr. Huggins had shown that the planetary nebulæ are all gaseous. Your own researches had confirmed this and had rendered it highly probable that all the irregular nebulæ are also gaseous. On the other hand, it had seemed that the clusters are a class apart, while the irresolvable nebulæ (not belonging to planetary or irregular classes) seemed to occupy a position midway between the two classes of gaseous and stellar nebulæ; since they showed in about equal proportions bright-line or continuous spectra. I was so convinced that this separation of the nebulæ into sets would be done away with after awhile, that I asked Mr. Huggins if it had occurred to him to look for signs of the bright-line spectrum superposed on the continuous spectrum given by the stellar nebulæ. He answered that his own view was similar to mine, but he had hitherto been unsuccessful in proving its justice. Lieut. Herschel's observations have supplied the necessary evidence. It is scarcely necessary to dwell on the significance of the facts thus brought together, (I repeat some facts already referred to):—

1. Irregular and planetary nebulæ affect neighbourhood of the Milky Way.

2. Irresolvable nebulæ segregate themselves from the Milky Way.

3. Clusters imitate the behaviour of the gaseous nebulæ.

4. The first and third sets of nebulæ belong to the extreme classes as respects gaseity or non-gaseity.†

---

* This letter, like that in No. 1, New Series, is from the rough draft of the letter actually sent; and I am unable to say in what degree the latter differed from the first form. I am under the impression that I sent a much condensed letter. It is so unusual with me to make a draft of any letter I may have to write that I feel sure I eventually sent a letter differing much from the present in form; but on the other hand the circumstance that I kept the rough draft convinces me that in substance this letter presents what I actually wrote.

† When we arrange the nebulæ (I.) in order of their apparent stellarity, (II.) in order of their gaseity, and (III.) in order of their

But, 5. All the classes of nebulæ are brought together again by the discovery that their gaseity is simply a question of proportionate degree.

6. All the classes (including the irregular class) are brought together in the Magellanic Clouds.

The main inference from this little set of facts, is that the gaseous matter so common in the nebulæ exists in all parts of the galactic system, and serves as a sort of index of the oneness of the sidereal and nebular systems.

The second omitted fact is the discovery made in recent times of the singular complexity of the solar system. Forced to take the solar system with which we suppose ourselves familiar as presenting in a general way a type of the wider system of which it is a part, we clearly are led to form different views now than analogy suggested when as yet astronomers knew so little of our system. The discovery of the asteroids has done much towards this change of view; but I think the knowledge recently acquired respecting meteor-systems tends much more importantly to give us just conceptions of the richness and complexity of our solar scheme. I do not so much refer to the strange discoveries recently made respecting the orbits of the meteors, the association of these bodies with comets, and so on; though the evidence on all these points seems too definite and complete to leave any room for question respecting them. The point to which Prof. Herschel has called so much attention—I mean the large number of meteoric systems which our earth traverses—and the consequent argument from probability that there exist millions of such systems within the solar scheme—seems to me far more important. It teaches us to look for an enormous wealth of relatively minute bodies in other systems, and therefore prepares us to look on the "suns" in the sidereal scheme as relatively few, the minute orbs and the groups of minuter orbs as relatively numerous.

extinction of light. It seems to me to have escaped notice that the arguments in favour of the extinction of light and those against it are equally irresistible on the accepted theories of stellar distribution.* The *argument* on which Struve founded his formula—brightness of a star $= \frac{1}{(\text{dist.})^2}\,(0{\cdot}990651)^{(\text{dist}-1)}$—has never, I believe, been disposed of; though arguments of equal force have disposed effectually of his extinction *theory*. Now I think that when irresistible arguments can be urged, on a given hypothesis, both *for* and *against* a certain theory, we may reasonably assume that there is something wrong about the given hypothesis.

You disposed of Struve so completely, for instance, that I believe every one has since looked on the theory of extinction as exploded; yet it was rather by arraying stronger arguments than his than by destroying the force of what he had put forward that this was done. *You* put the matter directly on this footing: but others who have quoted the result have quite forgotten that a difficulty was admittedly left unaccounted for. (I am not referring to Struve's misinterpretation of some words of your father's, but to his argument drawn from the insufficient number of faint stars.)

According to the views I have been led to form the question of the extinction of light seems an open one—but several facts seem to suggest that there *is* appreciable extinction even within such a distance as separates α Centauri from us.

I think on a reconsideration of my views you will see that (according to them) increase of distance would not necessarily lead to nebulous light. It seems to me that neither does the presence of irresolvable nebulous light necessarily indicate extreme distance, nor the converse. If we have a certain group of stars, and that group be supposed to move continually away, the question whether it will ever become nebulous (with *any* power if there be no extinction, or with a given power if there be extinction) depends wholly on the relation between the size of

Fig. 1.—A star-group.

Fig. 2.—Imagined—but impossible shape of a star cluster like that in Fig. 1.

Your father had no such analogy to guide him; but he was, I believe, so steadily progressing towards a change of view respecting stellar distribution (I judge from some of his later papers) that I think he might soon have been able to reverse the analogy, and *infer* the existence of multitudes of minute bodies within the solar system from the analogy which the sidereal scheme presents.

Lastly I should have referred to the question of the

the component stars and the distances which separate them. If the two stars A and B, in the cluster shown in Fig. 1, are of such size and so distant that when just disappearing to the naked eye they are clear of each other in appearance, they will be equally so when just disappearing for any power whatever, unless there is extinction.

We know there are parts of the Milky Way where there is irresolvable nebulosity: and the question at once suggests itself, Have we any evidence whether this is to be looked upon as a proof of indefinitely vast extension of the galaxy in direction of the nebulosity? It seems to me that we have positive proof that this is *not* the case. I will take the case of the clustering aggregation in Perseus. Your father's account of this spot shows that

association with the Milky Way, we get the following three columns:—

I.	II.	III.
Clusters.	Planetary and Irregular Nebulæ.	Clusters.
Irresolvable Nebulæ.	Irresolvable Nebulæ.	Planetary and Irregular Nebulæ.
Planetary and Irregular Nebulæ.	Clusters.	Irresolvable Nebulæ.

Mr. Huggins's discovery (confirmed by Lieut. Herschel's observations) that the gaseous nebulæ show a faint continuous spectrum as well as the bright-line one; and Lieut. Herschel's discovery of the converse fact that stellar nebulæ show a bright-line spectrum as well as the continuous one, make tables I. and II. highly significant.

* When I speak of accepted views I refer to those which are continually described in treatises on astronomy as the direct fruits of your father's researches and your own: I know well that there is not a single line either of your own or your father's writing in which the question of stellar distribution is spoken of as one on which we are in a position to form a definite theory.

B

every accession of power is followed by the resolution of more and more of the spot, but that the highest powers fail to resolve some parts. Also the spot contains stars of the seventh magnitude. If then we are to look on irresolvability with given powers as a test of distance, the true figure of the system which appears to us as a spot is a frustum of a cone—as A B D C, Fig. 2—having the sun, S, at its vertex. And from the size of the largest telescope used by your father (irresolvability under which implied, he considered, a distance which light would take 20,000 years in travelling) we should have A B at least 100 times greater than C D. This seems utterly contrary to all reasonable probability; and I think we have precisely the same sort of argument here which you have drawn from the Magellanic Clouds—the conclusion being, that within limits of distance which are as about seventy to seventy-one (remembering the small area of the spot in Perseus) there may coexist stellar arrangements resulting in all degrees of resolvability, from star groups almost resolvable by the naked eye down to absolute irresolvability in the largest telescopes man has yet constructed. Irresolvability being thus shown to be no test of distance, it seems to follow, *e converso*, that absence of nebulous light under given powers is no proof of relative nearness.

If the gap in Ophiuchus is really due to distance, however, there are certainly some indications we might look for along the fading extremities of the two arms which here extend towards each other. One is as you point out the diminution of star-magnitude; but it is to be noticed that all we could look for is the absence of stars of the brighter telescopic orders. The background of this part of the Milky Way would not differ from the background elsewhere. There would be stars of all orders from those just visible up to a certain magnitude—elsewhere there would be stars of all orders from those just visible up to a certain higher order of magnitude. The difference could only be determined by careful and systematic observation directed to that special end. If there is no such difference my notion about the Milky Way would have to be abandoned, or at least looked on as not probably correct.

You will notice that my theory indicates the possibility that an infinite variety of constitution may exist in different parts of the Milky Way.

I am not sure that one could expect the Milky Way near Crux and thence to Argo to present any obvious signs of the structure I suggest—supposing my suggestion correct. The apparent difference between the nearer and farther streams would be very slight. Even in our own neighbourhood questions of relative distance are so difficult to determine, that one might expect this one to defeat any save the most systematic inquiry, directed to the special purpose of determining whether there are any signs to guide us here. I am perplexed by the appearance given to the Milky Way in this neighbourhood in the large maps of the S. D. U. K. The rest of the Milky Way is shaded to a uniform tint, and is obviously incorrect in many places. But in the south-polar map the artist has suddenly indulged in the strangest variations of shade. What authority he had, if any, is not stated. One cannot help feeling he must have had some—perhaps notes by Lacaille or others. *Inter alia*, the Milky Way is shaded much more darkly along one side of the Coal-sack than along the other; and presents in an exaggerated form all the appearances my theory would lead one to expect. Whether some southern traveller noticed a slight difference of brilliancy, which has somehow been expanded into the singular arrangement I have mentioned, or whether the whole matter is the result of carelessness I cannot say: but one actually seems to see one stream crossing the other. This I noticed after my theory was formed, so that I was naturally rather interested in the peculiarity: but if there *is* any such difference of brilliancy it must be very slight. Would it be possible that such a feature could have escaped your notice? You remember Faraday used to say when an experiment was to be shown him "What am I to *look for?*" And it seems just possible that not having the thought of looking for such a feature or of attaching any importance to it if seen, it might have escaped even your unrivalled powers of observation. I put forward this view with extreme diffidence, and am quite prepared to accept your opinion as decisive as to the appearance of the Milky Way here, if you feel clear that the delicate difference in question could not have escaped you.

According to my theory, the proper motions of the stars in Crux should be larger towards the α end of the cross than towards the other. I try the experiment, though without putting very much faith in it—as the proper motions assigned to southern stars seem to require revision.

Fig. 3.—Proper motions (in 36,000 years) of stars in the Southern Cross.

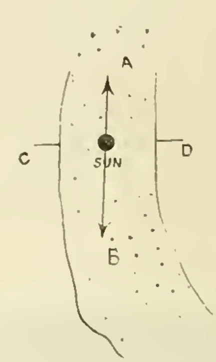


Fig. 4.—Illustrating the effects of our sun being in the midst of a stream of stars.

One cannot make much I fear from what is shown in Fig. 3. Of course it is part of my theory that the bright stars, such as those in Crux, sway the Milky Way wisps, and are mixed up with them.

I did not mean to suggest that the sun is altogether out of the plane rich in stars within which the Milky Way streams have (according to my view) been formed. But I cannot find any other interpretation of a well-defined edge *anywhere* along the Milky Way, than this, that the sun is out of that particular gathering to which the edge belongs. He might be on one part of the stream and we should still see such an edge when looking at other parts. But there is this difficulty:—If the sun is altogether out of the stream, but near its medial plane, we should see precisely the sort of increase towards the galactic plane that we actually observe, the stream only being the nuclear line (if one may speak so incorrectly) of a spiral region rich in small stars. But if the sun were *in* a stream, we ought to see an aggregation of small stars towards two opposite points on the heavens—as towards A and B (Fig. 4)—and a zone wanting in small stars towards C and D.

I am not so fond of my twisted-stream theory as not to recognise its weak points. But it seems to me we are forced to take *some* stream-theory, when we apply the laws of probability to the appearances presented by the

Milky Way. I think too that we are bound to look on the stars composing the Milky Way as really minute in comparison with Aldebaran and its like. Projecting the Milky Way to the distance due to the apparent smallness of its component stars assumed nearly equal to lucid stars, I cannot understand the many singular correspondences between its arrangement and that of the brighter stars. But looking on it as a stream swayed by the leading stars, one seems to get a general conception of its nature according satisfactorily with observed appearances.

Have you ever noticed the singular contrast between the poverty of the heavens (in lucid stars) from Centaurus to Monoceros on one side of the Milky Way, and the extreme richness from Crux to Orion on the other side? [See map on p. 89, drawn since above was in type.]

Your suggestion that the Galaxy contains within itself miniatures of itself, is very beautiful, and doubtless points to a great truth, as yet but dimly seen.—Yours very truly, R. A. PROCTOR.

THE UNIVERSE OF STARS.

EXTRACTS FROM

LETTERS TO RICHARD A. PROCTOR.

BY SIR JOHN HERSCHEL.

Collingwood, Aug. 20, 1869.

ONE of the arguments advanced in favour of spatial extinction of light was that *if not* the whole heavens ought to be one blaze of solar light—admitting the universe to be infinite, because it was contended that there could then be no direction in space in which the visual ray would not encounter a star—*i.e.*, a sun. This argument is fallacious; for it is easy to imagine a constitution of a universe literally infinite which would allow of any amount of such directions of penetration as *not* to encounter a star:—

Granting that it consists of systems subordinated according to the law that every higher order of bodies in it should be immensely more distant from the centre than the next inferior order, this would happen. Thus in our own—the moon is very near the earth and the satellites to their primaries. These primaries are immensely more distant from the sun, *their* centre. The fixed stars again still more immensely more remote from the sun. Suppose *our* system to terminate with the visible fixed stars. Then imagine a system of such systems as remote from each other *in comparison with their own dimensions*, as the distance of the fixed stars in comparison with the diameter of the solar system. Such systems seen from each other would subtend no greater angle than a star seen from the sun,* and so on.

May 11, 1870.

Among the innumerable ways in which an almost infinite multitude of luminaries of all sizes and brightnesses, from [10,000 suns] down to [an ounce of red-hot stone]* may be distributed in space, so as to appear to our eyes and telescopes just as our Milky Way and sidereal firmament does, I see no distinct reason for or against a spiral, discoid, annular, or cellular arrangement. As regards the openings in the form of "Coal-sacks," I do not quite see that what you say ("Other Worlds than Ours," 1st Edition, p. 256) as to a channel having a particular direction and perfectly straight, is necessary.

Imagine, for instance, such a form (not merely plane, but tridimensional) as *this* (Fig. 5) for the star-groups and galactic masses. This would leave quite as good a passage for the visual ray out into space as the neatest cut chimney.†

Collingwood, April 1, 1870.

I have been examining my star-gauges in reference to the very curious and interesting statistical relations your letter communicates [these are given in my essay on a novel way of gauging the star-depths, "Essays on Astronomy."—R. P.]; but I see that in so far as the relation of the grouping to the plane of the Milky Way is concerned, the results there arrived at [that is in Sir J. Herschel's star-gauges] are applicable only for stars below 8 mag., and for stars 8 mag. and upward those gauges afford no ground for any conclusion one way or other,—*i.e.*, in the mode in which they are there grouped.

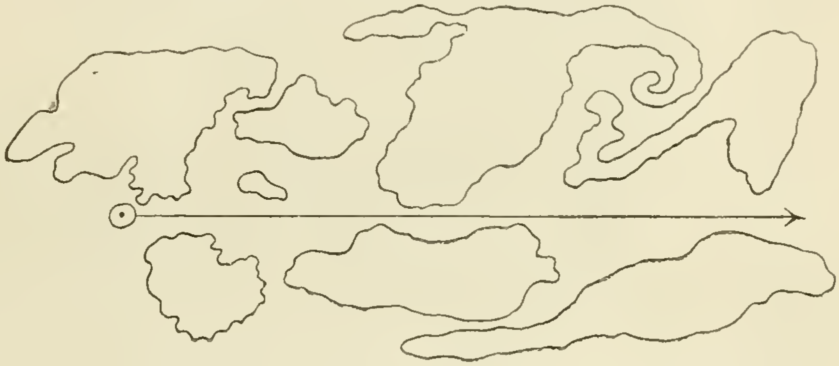


Fig. 5.—Showing how a "coal-sack" in the Milky Way may be explained.

It would perhaps be worth while to regroup them [be it understood that Sir John Herschel is here referring to his own gauges] for the regions within and without your boundary-line which—if I understand you right—divides the globe of stars 6 mag. and upwards into two very unequal segments—a rich and a poor one—having to each other the radii of about 5 to 2 in area, with no reference to the Milky Way, but cutting straight across it!—certainly a very startling fact, and none the less so that it should have the *Nubecula Major* for its centre. Still it seems almost too sudden to jump to a conclusion as to a real concentricity resulting from a physical connection—the more especially as the B. A. Catalogue can

* Wherefore it follows, we may note in passing, that the nebulæ which subtend much larger angles than this are utterly unlike the neighbouring galaxies as analogy would lead us to expect; that these would appear to us—that is as mere points in apparent size, and as also exceedingly faint in apparent intrinsic lustre.—R. P.

* The brackets here are used as in mathematics. Sir John intended me to understand that each luminary might be anything from a group of 10,000 suns down to an ounce of red-hot stone. Without the first pair of brackets, I might have understood him to represent a multitude of luminaries, instead of a single luminary, by the 10,000 suns. The second pair of brackets was rendered necessary—logically—by the use of the former pair which could not be avoided. This condensed way of writing is very convenient and useful when the writer knows that his correspondent will not misunderstand him; but of course it would be very unsuitable in addressing the general public on scientific subjects.—R. P.

† The only objection is that the overlapping star-clouds would give marked variations of brightness around a "coal-sack," whereas a general uniformity is observed.—R. P.

Fig. 6. Equal-Surface Chart of 324,198 Stars (from Argelander's series of 40 large charts).

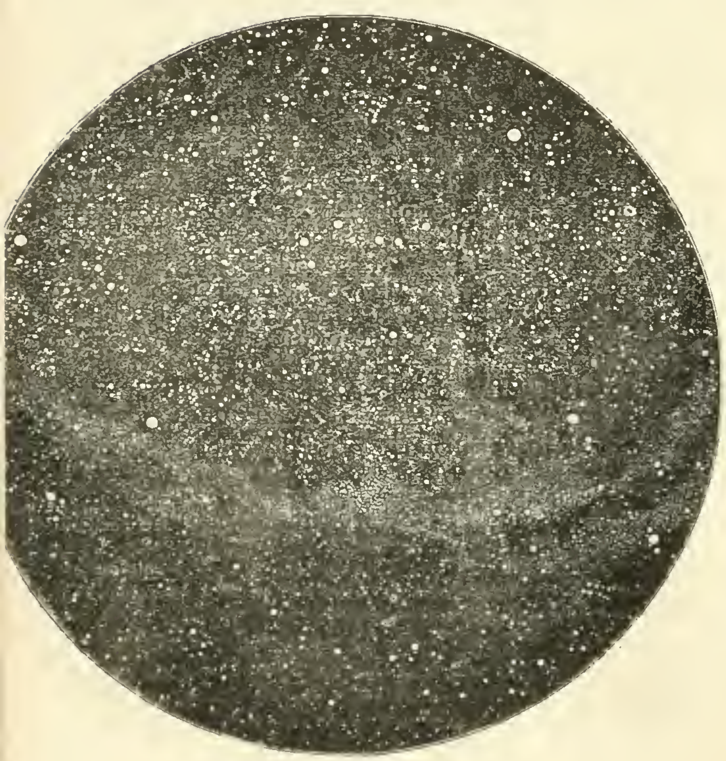


Fig. 7. Equal-Surface Chart of Northern Stars visible to the naked eye.

Fig. 8. Equal-Surface Chart of Southern Stars visible to the naked eye.

hardly yet be taken as effectively defining the limit of demarcation between 6 mag. and 7 mag.

Collingwood, July 28, 1870.

I thank you for calling my attention to that section in my "Outlines."* Undoubtedly there *is* a discordance of statements which requires correction. But the appeal there is rather to the statistical result of actual enumeration; and assuredly on a cursory view of the heavens on a clear night, stars down to the 7th and 8th magnitude *do* affect the eye, though we cannot *fix* them by reason of that strange law which curtails a star *directly* looked at of a very large aliquot part of its photometric effectiveness.

I am very glad you are taking an independent line, and utilising the immense additions which have been made to Uranography in the way of numerical accumulation and improved knowledge of proper motions, &c. We may—indeed must—form theories as we go along [what else do we observe *for?* R. P.] and they serve as guides for inquiry, or suggestions of things to inquire—but as yet we must hold them rather loosely, and for many years to come keep looking out for side-lights.

[I had submitted to Sir John Herschel my idea of a method of presenting his gauges of the southern heavens (and also, if possible, his father's) on an equal surface projection. I may remark that the idea was never carried out by myself, because Mr. Sidney Waters kindly undertook to carry it out: and placed his results, published in the Monthly Notices of the Astronomical Society, at my disposal. His valuable chart will be found in my "Universe of Stars." What prevented me from attending to that work was that I had entered on another work of a far more laborious nature, and calculated to throw much clearer light on the subject of stellar distribution in space. I refer to my equal-surface chart of the stars in Argelander's series of forty large charts. This chart, which I was not able even to begin (so few were my leisure hours) during Sir John Herschel's life, occupied me about 400 hours, which I could only with great difficulty make free out of my working time. I give a small copy of this chart as Fig. 6, an electro of which was kindly given me by M. Flammarion, in company with the two equal-surface charts of lucid stars, referred to by Sir John Herschel later on, as Figs. 7 and 8. Electros of these also were presented to me by M. Flammarion,—in consideration for the use of these illustrations—perfectly free to him however in any case—in his *Revue Mensuelle de l'Astronomie Populaire.*—R. P.]

Collingwood, July 28, 1870.

I have been thinking over plans for laying down the star-gauges, and I can light on none that seems to promise better than that which you suggest. The chief obstacle to carrying it out will, I suppose, be found in the fact that often all the gauges do not cover the whole surface, and that there are necessarily considerable areas unganged.

July 31. I have kept this unfinished in hopes of being able to lay my hands on the mass of graphical projections, &c., which formed the groundwork of what is said about the distribution of stars in galactic parallels in my Cape observations, thinking they might save you some trouble. I know they exist, but after a great search and turning over the contents of many portfolios and boxes, I have been unable to lay hands on them—so I will not longer delay replying to your letter—and doubt not that you will quite as well accomplish your object from the registered statement of gauges—both those of my father and my own.

Collingwood, Feb. 7, 1871.

The two star-charts you have been so good as to send me (Figs. 7 and 8), are very interesting. The contrast between the star density under the arch of the Via Lactea to the right of the *Nubecula* in the southern chart as compared with that in the diametrically opposite place in the northern is striking. By the bye I miss the *Nubecula Minor* in the former. [See map on p. 89.]

* I had noticed that Sir John Herschel's recognition of a band of bright stars running nearly on the line of the Milky Way was not in accordance with his remark that stars of the higher orders are not more richly strewn in the Milky Way than elsewhere.—R. P.

EVOLUTION OF LANGUAGE.

By Ada S. Ballin.

II.—SOUND CHANGES.

I REFERRED (New Series, No. I.) to the natural selection of sounds according to individual and racial peculiarities, which is one of the chief causes of change in language. The extent of this selection may be gauged by the fact that, although, according to Prince Lucien Bonaparte, no less than 310 consonantal sounds can be articulated, even the most cultivated languages make use of but a small fraction of this number, while the less cultivated show a quite remarkable poverty. Thus, Hindustani has 48 consonants, Sanscrit 37, or, if we count the Vedic *l* and *lh*, 39; Turkish, 32; Persian, 31; Arabic, 28; Kafir (Zulu), 26 and several clicks; Hebrew, 23; English, 20; Greek, 17, of which three are compound: Latin, 17, of which one is compound; Mongolian, 17 or 18; Finnish, 11; Polynesian, 10 native consonants, of which many dialects have less. Some Australian languages have 8, with three variations. The poorest of the Melanesian group has 12, and others 13, 14, or more consonants. Looking at the chief European languages in respect to vowels as well as consonants, we find that the simple sounds in English are 40, French 35, German 28, Italian 28, Spanish 26, and Portuguese 29. The number of sounds is greatest in languages whose speakers mix largely with other nations, and almost unconsciously learn from them. The Hottentot language, however, is said to have no less than twenty simple vowels and about twelve diphthongs, but its consonants are deficient, and largely consist of gutturals. They are supplemented by four clicks—dental, palatal, cerebral, and lateral—which are apparently relics of original sounds differing little from those of the lower animals. The poverty of such languages as Latin and Greek may be attributed to the dominant character of the minds of their speakers, which forbade their adopting sounds from the races they conquered; this exclusiveness hardly exists at the present day. But, new sounds are rarely adopted into a language unless the mental and physical constitution of the race is hardy: and even when they are adopted, the sounds take on a different character in the mouths of the new speakers. The *h* in French is a German peculiarity, and the *gui* a Roman attempt to render the German *w*. Thus, *hamea* is our *home*, *guichet* our *wicket*. On the other hand, the sound of *u*, as in *pure*, arose from an attempt to pronounce the French *u* in *pure*. *Ch* and *j*, in English, are of Roman or Norman origin, but have been adapted by analogy to many words of Saxon pedigree, as *child*, Anglo-Saxon *cild*.

The Otyi-herero has neither *l*, *f*, nor *s*, *r*, nor *z*. Its pronunciation is lisping, owing to the fact that the

Vaherero have their four lower front teeth knocked out, and the upper ones partially filed away, and it is probably owing to this fact that the language possesses sounds similar to the English hard and soft *th* and *dh* sounds. The Dinka language is without sibilants, owing to similar mutilations of the teeth, and it has neither *h* nor *ch*, possessing instead *ng* and *gh*, as in Arabic. Neither the Mohawks, Senekas, Onandangos, Oneidas, Cayugas, nor Tuscaroras have any labials; and the same is true of the Hurons, in common with other American tribes. Several languages do not distinguish between *k* and *g*, and the hard sound of *g* as in *go*, and the soft sound as in *gem*, as well as *z* soft as in *zone*, although frequent in Kafir, are unknown in the Bechuana alphabet. The dialect of the Society Islands is without gutturals, and their nearest approach to the name of Captain Cook was *Tute*. Although dentals seem to be common to every language, *d* is not used in Chinese nor in several American dialects. *S* is unknown to the natives of Australia, and its place in several Polynesian languages is taken by *h*, while it is entirely absent in Rarotongan. Sanscrit has no soft sibilants, nor short *e* and *o*, Greek has neither *w* nor *f*, Latin no soft sibilants, nor hard aspirates *th*, *ph*, and *ch*, and so on. *R*, a difficult letter to individuals and nations, is never pronounced in Chinese, nor by the Hurons, Mexicans, Othomi, and other American peoples. It is absent from the Kafir language, and from several Polynesian tongues: it is most frequently represented by *l*. Thus in Chinese, Christ is Ki-li-sse-tu, while in some of the Polynesian dialects it is Kalaisi.

In many cases it seems to be the fault of hearing, which is not sufficiently fine to discriminate between certain sounds, and thus leads to difficulties in pronunciation. Thus, according to Mr. A. J. Ellis, Sir John Herschel heard the same vowel in *spurt*, *assert*, *bird*, *virtue*, *dove*, *oven*, *double*, *blood*; but I hear a very different sound in the first four to the sound of the second four, and thus divide them into two groups. On the other hand, Sheridan and Smart distinguished between the vowels in *bird* and *work*, and in *whirl'd* and *world*, whereas I hear the same vowel in all four words, unless they are pronounced by Scotch people. Webster apparently did not distinguish between the sounds *tl* and *cl*, and *gl* and *dl* in English; for he says in his dictionary *clear* and *clean* are pronounced *tlear* and *tlean*; *glory* as *dlory*. Similarly in the Sandwich Islands, *k* and *t* seem to be confused. For the same word that Protestant missionaries will write with a *k*, the French missionaries will spell with a *t*. The Hawaian does not distinguish between *k* and *t*, *k* and *g*, *g* and *d*, *t* and *d*, *p* and *b*, *l* and *r*, and the word which in one of its dialects is *koki*, in others is *koi*, *kela*, *tea*. In Hawaian the English word *steel* becomes *kila*. As an instance of the omission of *r* and the interchange of *g* and *d* I have heard children say *keggy* for *cradle*. In such cases it is possible that both the hearing and the vocal organs are at fault, and the same may be true of a personal instance I can quote. My eldest sister informs me that when I was about seventeen months old she tried to teach me to sing these lines:—

> Farmer went to market,
> Up-a-gee-whoa! up-a-gee-whoa!

But the nearest approach I could make to this important phrase was,

> Mangy, mangy, mangy,
> Ubbababo, Ubbababo,

the "ng" being pronounced as a soft nasal. Thus the rhythm and some of the vowel sounds were caught and reproduced; but the consonants were beyond me.

The letter *f* does not exist either in Sanscrit or in the less-cultivated Finnish, and many English children find it difficult to pronounce; my brother, when a little boy, substituted *th* for *f*, as, *thilthy* for *filthy*, and apparently he could not hear the difference between the two sounds, for he always stoutly maintained that he pronounced these words rightly; so much so, indeed, that our first and almost our only quarrels were on this point. Children also frequently substitute *t* for *k*, and also for *f*, as *tat* and *titten* for cat and kitten, *tootie* for *foot*, in which example we also see the tendency common to many languages to make words end with a vowel.

In various Japanese, American, and African dialects *l* does not exist; nor is it found in the Cuneiform inscriptions, nor in Zend. It is represented by *r*, *n*, and even *d*, as German *kind*, Anglo-Saxon *cild*, English *will*, from the Sanscrit *mar*, to rub. Children sometimes say *grass*, *ritten*, *dound*, for *glass*, *little*, *round*, and such individual peculiarities of pronunciation are legion. Conversely from the example given above, *th* is frequently changed into *f* by children and vulgarly, as *nuffin* for *nothing*. Children not only frequently end their words with added vowels, but they also insert vowels between two consonants, similarly a Hawaian would pronounce *cab*, *caba*; and Appleyard* gives the following Kafir adaptations of English words—*bapitizesha*, to baptise; *igolide*, gold; *inkamela*, camel; *ibere*, bear; *umperisite*, priest; *ikerike*, kirk; *umposile*, apostle; *isugile*, sugar; *ama-Ngezi*, English.

The tendency to which I have just referred to make no distinction between such sounds as *k* and *t* has led Prof. Max Müller† to make the following remarks, which are of great interest from a philological point of view. He says:—

> If colonies started to-morrow from the Hawaian Islands, what took place thousands of years ago when the Hindus, Greeks, and Romans left their common home, would take place again. One colony would elaborate the indistinct, half-guttural, half-dental articulation of their ancestors into a pure guttural; another into a pure dental; a third into a labial . . . . without attenuating circumstances, I cannot conceive of a real *k* degenerating into *t*, or *t* into *p*. I can conceive different definite sounds arising out of one indefinite sound, and those who have visited the Polynesian Islands describe the fact as taking place at the present day.

These remarks form a natural introduction to the explanation of Grimm's Law. The phonetic law, which Prof. Max Müller was the first to call Grimm's Law, applies to nearly the whole consonantal structure of the Aryan languages. There are three chief points of contact of vocal organs which produce consonants—the guttural *k*, the dental *t*, and the labial *p*. Each of these may be uttered hard with explosive force, *k*, *t*, *p*, or softly *g*, *d*, *b*, and are liable in certain languages to be aspirated, as in Sanskrit, where the system is complete, and we have *kh*, *th*, *ph*, *gh*, *dh*, *bh*. In old Greek the hard aspirated checks χ, ϑ (*th* as in both), and ϕ existed, but in later Greek they dwindled down to *gh*, *dh*, *bh*, which do not require so great an effort in pronunciation. In Latin there are no real aspirates, their places having been taken by the corresponding breathings *h* and *f*. Grimm's Law is a statement of the fact that—1. If the same roots or words exist in Sanskrit, Greek, Latin, Celtic, Slavonic, Lithuanian, Gothic, and High-German, then wherever the Hindus and Greeks pronounced an aspirate, the Goths and Low Germans generally, the Saxons, Anglo-Saxons, Frisians,

* "Kafir Language," p. 89.

† "Lectures on the Science of Language," ed. 1871, Vol. II. pp. 199-200.

&c., pronounce the corresponding soft check, the old High-Germans the corresponding hard check. 2. If in Greek, Latin, Sanskrit, Lithuanian, Slavonic, and Celtic, we find a soft check, then we find a corresponding hard check in Gothic, a corresponding breath in Old High-German. 3. When the six languages named above show a hard consonant, then Gothic shows the corresponding breath, Old High-German the corresponding soft check. In Old High-German, however, the law only applies to dentals, *h* and *f* generally appearing in documents instead of the soft consonants *g* and *b*. The following table* clearly shows the changes which take place under Grimm's Law, and I reprint it not only because it is one of the best illustrations of how words may be altered by change in the uttered sounds, but also because the law is so often referred to in various works, that it is useful to know exactly what it is.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Sanskrit	gh (h)	dh (h)	bh(h)	g	d	b	k	t	p
Greek	ch	th	ph	g	d	b	k	t	p
Latin	hf(gv)	f (d b)	f (b)	g	d	b	c qu	t	p
Old Irish	g	d	b	g	d	b?	c (ch)	t (th)	(p)?
Old Slavonic	g z	d	b	g z	d	b	k	t	p
Lithuanian	g z	d	b	g z	d	b	k	t	p
Gothic	g	d	b	k	t	(p)?	h g (f)	th d	f b
Old High-German	k	t	p	ch	z z	f ph	h g k	d	f b

Thus, 1, *garden*, Gothic *gards*, Latin *hortus*, Greek *chórtos*; 2, *deer*, Anglo-Saxon *deor*, Gothic *dius*, Greek *thēr* or *phēr*, Latin *fera*, Old High-German *tior*: 3, *beech*, Old High-German *puocha*, Gothic *boka*, Latin *fagus*, Greek *phēgós* (meaning oak); 4, *corn*, Old High-German *chorn*, Gothic *kaurn*, Lithuanian *girnis*, Slavonic *zrno*, Latin *granum*, Sanskrit *girna* (meaning *ground down*); 5, *timber*, Gothic *timr* or *timbr*, from which *tinrjan* to build, German *zimmer* a room, Latin *domus* house, Greek *dómos* house, *démein* to build, Sanskrit *dama* a room; 6, few Saxon words begin with *p*, and no Gothic words, unless foreign importations. In Sanskrit, also, *b*, which ought to correspond to Gothic *p*, is seldom an initial sound, being replaced by the labial breathing *v*; 7, *heart*, German *herz*, Old High-German *herza*, Gothic *hairto*, Latin *cor*, Greek *kardia*: 8, *three*, High-German *drei*, Gothic *thrais*, Latin *tres*, Greek *treis*, Sanskrit *trayas*; 9, *fare*, as in *welfare*, German *wohlfahrt*, Greek *póros*, a passage.

"Sound etymology," as Max Müller has epigrammatically remarked, "has nothing to do with sound," and the following rules laid down by him should never be forgotten in an inquiry such as the present:—

1, The same word takes different forms in different languages; 2, The same word takes different forms in the same language; 3, Different words take the same form in different languages; 4, Different words take the same form in the same language. The time has gone by for etymologies based purely on analogies of sound, such as we find, for instance, throughout Webster's magnificent dictionary, where Chaldee is stated to be the original language, and the Greek *para* and English *over* are connected with Hebrew *ngabar*, to pass over; Greek *agathos*, English *good*, &c., with Arabic *gada*, to be useful, profitable; English *like*, German *gleich* with Hebrew *khalak* and Arabic *khalaka*, to be smooth; and so on. The study of Sanskrit and the consequent discovery of Grimm's Law put an end to this kind of loose etymological guesses, and placed the science of language upon a firm foundation. We can now trace the unity of words through great diversity of sounds, and we can do this to such an extent that some writers have maintained that all the words in all the Indo-European languages can be traced back to as few as nine original roots—a subject to which I shall refer hereafter. To see how far words may differ from their originals, look at our word *lord*, from Anglo-Saxon *hlaford*, *sexton* and *sacristan*, French *sacristain*, from the Latin *sacristanus*; *bishop* and French *évêque* from Latin *episcopus*. Endless other examples might be quoted, but I have said enough to illustrate the power of phonetic decay in changing the form and sound of words.

Among the various causes to which such changes in language may be attributed, two of distinctly opposite natures are found to be preeminent:—1. Economy of effort, by which the mass of the people conveys its thoughts in the easiest possible way. 2. Elaborate expression with extreme distinctness of utterance, necessary to great orators and philosophers as a means of leading the masses, and conveying to their hearers in not-to-be-mistaken phrases the ideas they wish to disseminate. By economy of effort difficult sounds are slurred over and dropped, the ends of words are chipped off, and sentences are left incomplete when it is apparent that they are understood; hence changes of this sort are especially liable to occur in families where the intercourse between the different members is constant, and thoughts are understood almost before they are expressed. The same thing, on a larger scale, takes place in the formation of dialects. The great object of language is to be understood, and so long as words are understood they may be pronounced in as slovenly a way as is convenient. We individuals are conscious that we speak in a different way to our own families to what we do in society. When we go entirely amongst strangers we use greater effort in order to be distinct in speaking, for if we addressed them as we do those with whom we are in constant intercourse, we should probably fail to be understood. This point becomes still more apparent if we have to address a large concourse of people. Our audience necessarily consists of a crowd of minds whose range of ideas and whose vocabularies differ greatly from our own, and it becomes necessary to make considerable effort in order that they shall understand every word we utter. Our words are, therefore, carefully chosen and emphasised, and every consonant is distinctly articulated. Thus, the necessity of being understood by those who are not in intimate communion with the individual speakers acts as a kind of break on that phonetic decay which takes place on the principle of economy of effort. These two apparently contradictory principles become reconciled by the great power of imitation, the mass being raised thereby to approach the level of the orators who lead them, while the orators themselves are not entirely free from the power of the principle of least effort, which influences even them, since much of their time is necessarily spent in familiar intercourse with their kindred.

Interesting and instructive as is the study of phonetic changes, it is far distanced in importance from a psychological point of view by the study of the changes of the sense of words. We have so far dealt with the purely anatomical evolution of language, but I hope in my next to discuss its intellectual growth, for in the changes of the meanings of words we find the history of the mental development of their speakers. We shall see how great things come from small beginnings, and how the noble abstractions of science have grown up from the gropings

* Taken from Müller's "Lectures on the Science of Language," vol. II., Lect. V., which see for further information on this subject.

of the savages who first sought to use the senses with which nature had endowed them, and to embody the images so gained in signs and sounds, in order to share them with each other.

THE SOUTHERN SKIES FOR JANUARY.

By Richard A. Proctor.

To begin with, I must explain that the map illustrating the Southern skies in January is merely tentative. I have included in it all the stars down to the fourth magnitude, inclusive; but I think the map is thus made too crowded, and that the series would be improved by excluding all fourth magnitude stars, except here and there some which complete well-known star groupings. Then as regards the delineation of stars and lettering:—I had decided to let professional draughtsmen prepare the charts from my drawings; but a careful examination of the present map has changed my opinion. My delineation and especially my lettering may be inferior to the work of professional draughtsmen in regard to *technique*, but for the purposes I have in view in such maps as these, my own work is I think on the whole better.* Again I have decided to use numbers hereafter for the southern constellations as I did for the northern. Any one who wants to learn the constellations can surely be at the pains to turn from the map to the list of names, to see what each number represents, and by freeing the map from overmuch lettering the plan makes them much clearer and more effective.

The map shows the starry sky as seen in Australia, New Zealand, Tasmania, Cape Colony, &c. (anywhere between south latitudes 30° and 45°) at about nine o'clock at night in the beginning of January, and at about seven o'clock at the end of the month.

Turning to the south, we find no polar star: (Mr. Hampden says that there is no pole, but mistakes). The nearest star to the pole in our map is β *Octantis*, a fourth magnitude star. Below the pole we see the Triangle (Southern) with *Pavo* (the Peacock) on the right or west, *Musca* (the Fly) and *Crux* (the Cross). These constellations with *Apus* (the Bird of Paradise) just below the pole, *Chamæleon*, *Volans* (the Flying Fish), *Pictor* (the Painter's Easel,—oh, those dullards who made the south polar constellations!), *Dorado* the Swordfish, *Reticulum* (the Net), *Hydrus* (the Water-Snake), and *Toucan* (the Toucan), are always visible in the southern region named, being circumpolar.

High up in the south-east we see the great ship *Argo*, wrong side up with care, the stars marked *Carina* showing the Keel, *Puppis* the Poop, and *Vela* the Sails. Naturally the sea-serpent *Hydra*, is flourishing her mighty length along the horizon underneath the masts and sails of the ship.

Due east is *Canis*, the Greater Dog, high up, and on his back, the Dove, *Columba* being perched on the Dog's hind feet.

In the north-east we see *Orion* on his head, but he makes nearly as fine a figure if his shoulder stars for our hemisphere are made leg stars for the Southern, and *vice versâ*. *Gemini*, the Twins, stand also on their heads, and by no means suggest the idea of Twins.

Taurus is the chief constellation towards the north at this time, just as from our hemisphere he is the chief constellation towards the south. Of course, it will be understood that the movement of Orion, Taurus, and all these other constellations in the northern skies of the Southern hemisphere, is from east to west, or from right to left.

Overhead, the winding streams of the river *Eridanus* extend from near β of Orion to between *Phœnix* and *Hydrus*, where the bright *Achernar* (α Eridani) is seen—a star now too far south to be seen from those places in the northern hemisphere where it used to be seen in the time when it received its name.

In the south-west quarter of the sky we see the Northern Triangle, *Aries* (the Ram), *Pisces* (the Fishes), *Cetus*, the Sea Monster, and *Aquarius*, the Water Bearer.

It would be idle to describe more fully the indications of a map which is only experimental, and not altogether a success, to my mind.

* The pairs of southern and northern maps which have already appeared in monthly Knowledge for November and December will enable the student to decide whether my mapping or the professional's is better for the purpose of these charts. The northern map in each case (that towards the right) is his, the southern map is mine. Of course my lettering, &c., may be very obviously the work of the amateur draughtsman, yet it serves its purpose; and I think I have managed to bring out the star groupings more clearly. Unfortunately the "process" by which the blocks are made is very unequal in its work—occasionally showing all the sharpness of the originals, but too often giving woolly and otherwise imperfect results.

INDIAN MYTHS.

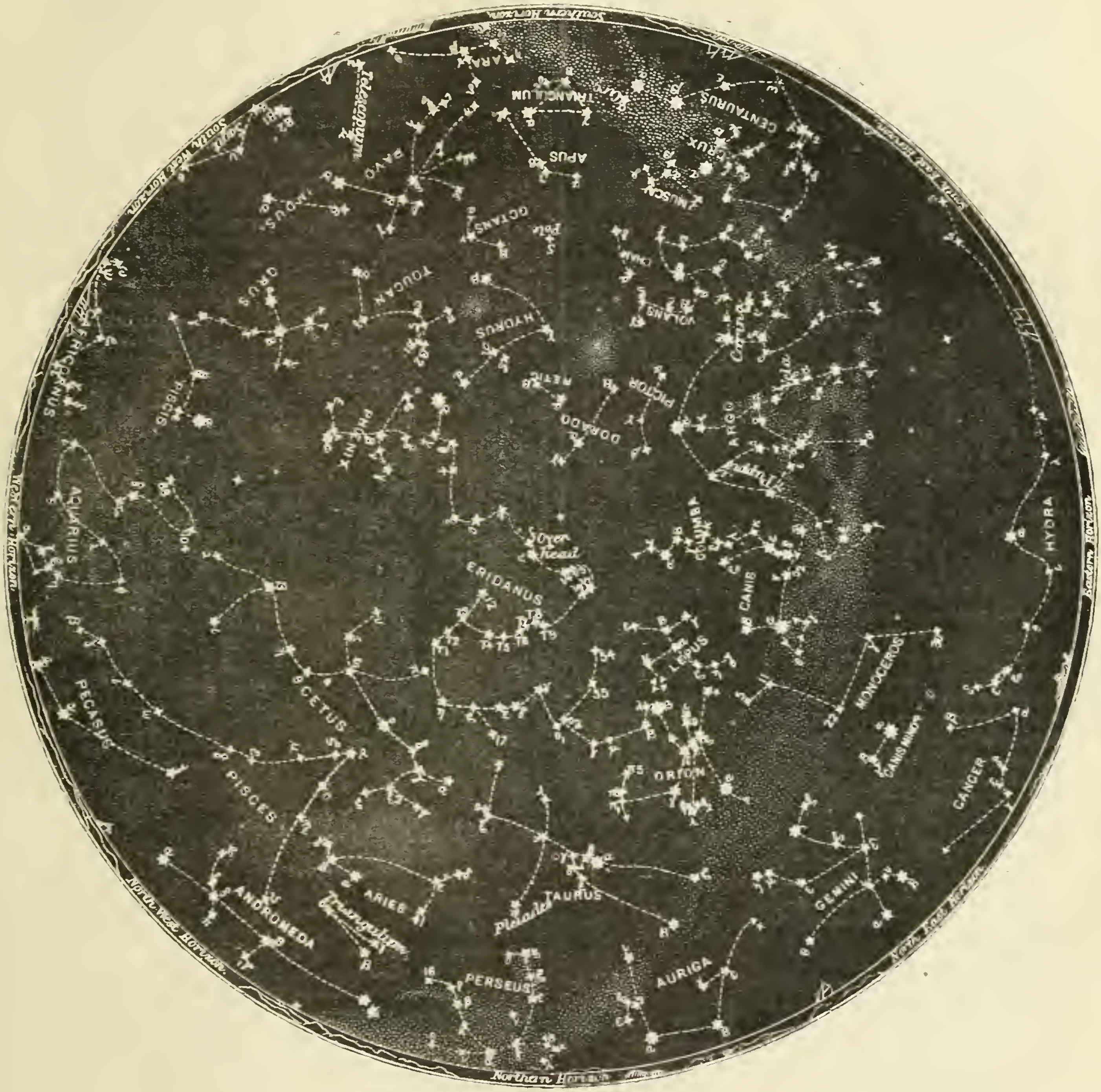
By "Stella Occidens."

Most beloved by Hiawatha
Was the gentle Chibiabos,
He the best of all musicians,
He the sweetest of all singers.
. . . .
All the hearts of men were softened
By the pathos of his music,
For he sang of peace and freedom:
Sang of beauty, love, and longing;
Sang of death, of life undying
In the Islands of the Blessed,
In the kingdom of Ponemah,
In the land of the Hereafter.

There is an old saying, that one half of the world knows not how the other half lives. For instance, it is generally supposed that the North American Indian is but a wild, untutored savage, differentiated from other savages only by his wigwam and his wampum, his war-paint and his tomahawk. In reality, he has thoughts and feelings of his own, and, above all, originality in his manner of expressing them. Mrs. Eastman, who lived seven years among the Sioux Indians, writes* that "The war-song, death-song, the song of victory, the cradle-chant, the lament for the slain—these are the overflowings of the essential poetry of their untaught souls. Their eloquence is proverbially soaring and figurative; and, in spite of all that renders gross and mechanical their ordinary mode of marrying and giving in marriage, instances are not rare among them of love as true, as fiery, and as fatal, as that of the most exalted hero of romance. Their legends embody poetic fancy of the highest and most adventurous flight; their religious ceremonies refer to things unseen with a directness which shows how bold and vivid are the conceptions of the imaginative."

The Indian has not much depth of thought, it is true. If anything puzzles him, he does not trouble himself to

* Mrs. Eastman's "Legends of the Sioux."



THE SOUTHERN SKIES IN JANUARY.

solve the problem. His mind is like a child's, which, not having as yet the power of sustained thought, easily wearies. If asked too many questions, he will answer at random. Sir John Lubbock tells us that, "Though savages always have a reason, such as it is, for what they do and what they believe, their reasons are often very absurd. Moreover, the difficulty of ascertaining what is passing in their minds is of course, much enhanced by the difficulty of communicating with them." Further on he tells us, that "Another source of error is that savages are often reluctant to contradict what is said to them."*

In this way we see how hard it is to obtain any definite knowledge of their myths and ideas generally, or to trace a clear line of thought accounting for some of the wild though beautiful legends which have descended from father to son for many generations. The Indian's knowledge is comparative, and within narrow limits is confined

* "Origin of Civilisation," p. 7.

the sum total of his belief. As he beholds day after day the wonders and beauties of nature, and at night gazes on the star-lit heavens, he must form some opinion about them, and attribute some reason for their existence. If he sees smoke in the distance he knows there is a fire, if he sees clouds in the sky he knows it is going to rain, for he has noticed that a cloudy sky precedes rain. We may imagine him gazing in wonder at the glorious stream of stars known as the Milky Way, and endeavour to trace the line of thought and observation which suggested the following beautiful story related in Schoolcraft's "Hiawatha Legends." It is called "The White Stone Canoe," and is a myth of the Dacotahs. "It is said that many years ago an Indian chief was about to be married to a beautiful girl who unfortunately died on the morning of the wedding-day. He was overcome with grief, but he was determined to see her once more. He had heard of the 'Spirits' Path,' and, hoping to see his bride again, he made a most remarkable journey. He travelled towards the south, and, at first, the hills and valleys were covered with snow. After awhile the snow disappeared, the leaves put forth their buds, and it was spring. He had left the land of ice and snow, and the dark clouds of winter had rolled by, disclosing the land of flowers and sweet singing birds, with a bright blue sky overhead. Soon he came to the path he was seeking, and it led him through a shady grove. After passing over an elevated ridge beyond the grove he reached a lodge. Here stood an old man with white hair and eyes of fiery brightness. Around his shoulders hung a robe of skins, and he leant on a staff. It was Chibiabos."*

He said to the young chief, "I have expected you, and had just risen to bid you welcome to my abode. She whom you seek passed here but a few days since, and being fatigued with her journey, rested for awhile. Enter my lodge and be seated, and I will then satisfy your inquiries, and give you directions for your journey from this point." After the chief had rested, Chibiabos gave him the following advice. "You see yonder gulf, and the wide-stretching, blue plains beyond. It leads to the land of souls. You stand upon its borders, and my lodge is the gate of entrance. But you cannot take your body along; leave it here with your bow and arrows, your bundle, and your dog; you will find them safe on your return." The chief did as he was told, and soon he was flying along the path as if he were a bird. Stranger still, he could pass through trees without any trouble, which proved that he was in the land of "shadows," and that these trees were but shadows. He saw many beautiful birds, and flowers, and everything bright and glorious. At last he came to the banks of a lake, and here he found a snow-white canoe. He untied it, and was soon paddling across the lake, when to his great joy and astonishment he saw his fair bride. She approached him in her canoe, and they crossed the lake together. The lake was covered with foam, and the turbulent waves threatened every moment to swallow them up. The travellers saw some whose boats were swamped, and as the water was wonderfully clear they could see the bodies of many who had been drowned.† The canoes in which little children travelled, however, met no waves, and they passed over in safety. After many difficulties the opposite bank was reached, and the happy pair sprang out on the land. They wandered together over the beautiful fields and meadows. Here they saw no suffering, for neither cold, nor death, nor hunger were present. The very air they breathed was food. The two would have wandered on for ever in their happiness, but the voice of the Master of Life, borne on the sighing breeze, bade the chief return once more to his native land. "Return to your people, and accomplish the duties of a good man," he said; "you will be ruler of your tribe for many days. When Chibiabos surrenders back your body he will tell you what to do. Your bride is accepted, and will be ever here, as young and happy as when I first called her from the land of snows." When this voice ceased, the chief awoke. "It was a dream, and he was still in the bitter land of snows, and hunger, and tears."*

There is something quaint and beautiful in this myth, and the fact of its being an established belief among many of the North American Indian tribes proves that dreams are accepted by them as fact. In the "Legends of the Sioux," Mrs. Eastman tells us that an old woman assured her that "the Dacotah has four souls. One wanders about the earth, and requires food; another protects the body; the third goes to the Land of Spirits (whilst sleeping); and the fourth hovers around his native village."† (The Pythagoreans give as their master's word that souls dwell in the Galaxy, and that the souls of those who are crowded there descend, and appear to men as dreams.‡) Thus they believe that every-one they see in their dreams, and everything they dream they do, are realities, but that this concerns the soul only. We read that the "Tagals of Luzon object to waking a sleeper on account of the absence of his soul."§ It would certainly be rather inconvenient for the sleeper to find himself awake without a soul. The Indian then, according to his own fancy, lives two lives, the waking and the sleeping life. Whilst he is awake he can control his own actions, but when he sleeps he believes that his soul leaves his body controlled by an unknown power, wandering far and wide, only to return when the owner awakes.||

* The aurora; or, possibly, the rainbow.

† The story of Charon, the ferryman, is to be found not only in "Homer," but in the poetry of many lands. The River must be crossed before gaining the Isles of the Blest. "Egyptian Belief," Bonwick, p. 49.

* "Hiawatha Legends," Schoolcraft, p. 223.

† "Legends of the Sioux." Mrs. Eastman. P. 190.

‡ Tylor's "Prim. Culture," vol. i., p. 359.

§ *Ibid.*, p. 442.

|| *Ibid.*, p. 49, vol. ii. Among the North American Indians, and especially the Algonquin tribes, accounts are not unusual of men whose spirits, travelling in dreams or in the hallucinations of extreme illness to the land of the dead, have returned to reanimate their bodies and tell what they have seen.

THE STAR OF BETHLEHEM AND A BIBLE COMET.

By Richard A. Proctor.

ONE of the strangest ways of the well-meaning but foolish persons who regard the student of science as the natural enemy of religion, is their habit of being angry with those who study the various books of the Bible for such light as these may throw on matters not specially connected with religious dogmas. Whether it is that they are in anxiety lest something not quite agreeing with their own peculiar notions about religious matters may be noted, or whether they assume that the student of science is necessarily an evil-minded person who cannot open the Bible except to find fault with it, does not appear. But they will not inquire into the historical or scientific evidence contained in the Bible themselves, and they grow exceedingly angry when any one else does.

Occasionally, however, we find them striking out both at those who do and at those who do not examine matters in the Bible which may be regarded as having a scientific or historical bearing. I have myself been personally abused in the most strenuous fashion for saying—in response too to special inquiry—that a certain description in the Bible did not (probably) relate to any known celestial body, and as earnestly rebuked for expressing my opinion that a certain description in the Bible did probably relate to a celestial phenomenon of a well-known class.

The first subject is the Star of Bethlehem. Here astronomy, following the rule of the Royal Astronomical Society—*Quicquid nitet notandum*—certainly has the right, if it is not even urged by the sense of scientific duty, to make inquiry: for here a star, observed by an astronomical race the Chaldeans (as I suppose the Magi to have been) is in question. However, here the class of persons who attribute to themselves—perhaps rather fondly—a specially religious character, have been beforehand with the student of science, and have claimed to give a scientific interpretation, or rather half-a-dozen incongrous scientific interpretations, to the record of the evangelist.

Now, we cannot overlook the fact that wherever the heavenly bodies are referred to in the Bible, they are regarded as placed in the heavens to be not only for seasons but for signs. "The stars in their courses fought against Sisera," is a saying which in old times no one misunderstood,—though nowadays some pretend to find a symbolical rather than an astrological significance in it. It is perfectly obvious that even to the very latest date covered by the books of the Bible the heavenly bodies were regarded as not only influencing and indicating, but as actually affected by, the fortunes of the human race. As the first book, nay the first chapter of the Bible, says (like the Assyrian tablets from which it was apparently derived), that the sun, moon, and stars were for signs, so the last speaks of the sun turning black as sackcloth of hair, of the moon becoming as blood, of the stars of heaven falling to the earth ("even as a fig-tree casteth her untimely figs, when she is shaken of a mighty wind") solely because the kings of this poor little earth of ours, and the rich men, and the chief captains, and so forth, were to be discomfited. It is as absurd to try to blind oneself to these clear indications of the ideas very naturally entertained in those days respecting the sun, moon, and stars, as it is to attempt to overlook the mistaken ideas men had then formed about the shape and dimensions of the earth, the laws according to which rain, wind, storm, snow, hail, and other natural phenomena are produced, the nature of epileptic and cataleptic seizures, madness, idiocy, and a number of other matters, which men nowadays begin to understand but then knew scarcely anything about. To imagine that revelation should be of such a nature that it would make a Bacon of a Moses, a Newton of an Isaiah, a Priestley of a Luke, or a Laplace of a Matthew, is surely to mock not to reverence Deity, at least it would be so if those who thus teach could see the utterly absurd inferences deducible from what they seem to believe.

Viewing matters as we find they actually were, it becomes a matter of considerable interest to the student of astronomy to ask whether any, and if any what heavenly body, may possibly have been referred to in the description given by the evangelist Matthew of what has been called the Star of Bethlehem. Many imagine that the star seen in 1572 was the same orb which had blazed out suddenly when Christ was born, and was regarded by his followers, afterwards, as indicating that he was the appointed "Governor that should rule God's people Israel." Some heavenly body, they say, which then appeared, is certainly referred to by Matthew: may it not have been the same which appeared in 1572? There is reason to believe that this is the same star which shone out at intervals of about 312 to 314 or 315 years before, and may shine out in 1886 or 1887—to announce, perhaps, as many imagine, the second (though according to the star it ought to be the sixth) coming of Christ. Whether this is so or not a few months now will determine. But reading Matthew's account as it stands it seems hardly likely (though it is by no means absolutely impossible) that it related to that particular orb.

The place in Cassiopeia where the star of 1572 appeared would in the beginning of the Christian era have been about 36° from the North Pole (much further away than now) and in about right ascension 22 h. 40 m. Thus at midnight in the latitude of Jerusalem, on or about Dec. 25, the star of 1572, if it had then been shining, would have been towards the north-west low down, which was not the right direction for the house in Bethlehem as probably approached from Jerusalem. Earlier the star would have been higher up, and therefore could hardly have been described as going "before them till it came and stood over where the young child was." Indeed could *any* star, or planet, or comet, be described in these terms? Manifestly (it seems to me) the evangelist meant to describe a purely supernatural phenomenon.

Yet for expressing, in response to especial inquiry, this very reasonable opinion, and rejecting as unreasonable the idea that a star hundreds of thousands of millions of miles from this earth, blazing out at tolerably regular intervals of 314 years, on account probably of some peculiarity in the movements of cometic and meteoric matter around it, had been as it were waited for in this case (instead of being made to wait upon the coming of the child, as the whole spirit of the evangelist's narrative implies) I have been rebuked as if possessed by a spirit of intensest hostility to religion itself.

This is absurd enough; but the absurdity becomes more intense when coupled with a converse absurdity of an equally ridiculous sort.

There is a passage in the history of David which seems to me to have a manifestly astronomical interpretation, and indeed—while perfectly in accordance (as so understood) with what we know of the ideas of the ancient Hebrews about such matters—to help to explain a very remarkable feature of all the books of the Bible.

The comet, most impressive and awe-inspiring of all heavenly bodies, is nowhere mentioned in the Bible—full though its pages are of passages showing how the Hebrews were impressed by the wonders of the star-depths. This is so remarkable that we are naturally led to inquire whether under some other name comets may not be referred to in the Bible. It seems likely on *à priori* grounds that the Hebrews would regard comets, even more confidently than other less impressionable races did, as special messengers from God. And as Hebrew writers did not hesitate to express their opinions on such points, confidently saying, for example, that the heavenly bodies were for signs, that the stars in their courses influenced the fortunes of a third-rate chief, and so forth, they certainly would have described comets as celestial messengers if they thought them so.

Thus led, we examine passages where they actually speak of celestial messengers, finding, to begin with, that the word they used for such beings actually meant a

heavenly body, an appearance in the heavens. a celestial apparition—and so would apply as well to a comet as to what we (not knowing much perhaps of the real significance of the old Hebrew word) translate as "an angel" and picture as a being clothed in stuffs of apparently human manufacture. Nor assuredly if a Hebrew writer regarded a star, planet, or comet, as a messenger from God. would he hesitate, when calling it an angel, to characterise it as an Angel of the Lord, for so certainly it would appear to him.

Now there are several passages where an angel or celestial messenger is described in terms which would apply very well to a comet; but there is one passage which, as I think, can be interpreted in no other way, without understanding a series of miracles, for which, so far as one can judge, the occasion was by no means worthy.

In the history of David we are told that having numbered the people he was informed by an ecclesiastic called Gad (who appears to have claimed to express the very thoughts and feelings of Deity—a practice not perhaps unusual with the priests attached to royal persons) that he had angered God exceedingly—though wherein the offence consisted is not clear. Be this as it may, David was left to choose between three punishments, of which he selected the one least likely to affect himself. So pestilence came "and there fell of Jerusalem seventy thousand people." So far all is perfectly natural, and doubtless historically accurate. But now suddenly an angel appears as "sent unto Jerusalem to destroy it," but bidden presently to stay his hand, and waiting,—"the angel of the Lord stood by the floor of Ornan" (elsewhere called Araunah) "the Jebusite." Gad appears to have been powerless in this emergency. Something there was which he and David and all men saw. There is no particular reason for supposing that just at that particular time in the history of that particular oriental race and of that particular (or in some respects not *very* particular) ruler, a miraculous apparition remained hovering (for how many days the account does not say, but it must have been quite a considerable time) in mid-air over Jerusalem. Yet something there was up there which terrified the people and David himself, and possibly Gad too, clearly though he claimed to see the meaning of the portent. David indeed wanted to go up to Gibeon to sacrifice before "the tabernacle of the Lord"; but he was afraid to go up that way because of the angel of the Lord, standing "between the earth and the heaven having a drawn sword in his hand stretched out over Jerusalem." (If this was not a comet, by the description, it was the personage referred to in the first verse of the self-same chapter—I. Chronicles, xxi.). David and the elders, clothed in sackcloth, fell upon their faces, as was perfectly natural—for a comet, not understood in its scientific aspect, as something to be timed, calculated, analysed with a spectroscope, and so forth, is a very terrible object indeed to look upon. Then Gad said that the celestial messenger had explained to him that David was to buy the threshing-floor of Ornan—one account says for fifty shekels of silver, but the other for six hundred shekels of gold—there to set up an altar, for sacrifice, burnt-offerings and peace-offerings, and other sacrifices such as in our days we scarcely think of offering "to the Infinite Power from whom all things proceed." Whereupon, we are told, that "the Lord commanded the angel, and he put up his sword again into the sheath thereof."

We need not smile at the simplicity of David and the elders,—possibly (let us hope) of Gad also, though the purchase of the altar has a doubtful look. For at the time of the plague and fire of London, people were equally ready to interpret the comets preceding those events as God's messengers. Defoe tells us that they saw those comets manifestly hovering over the city, nay heard the crackling of the flames proceeding from the one which forewarned the coming of the great fire. Medals were struck, and are still in existence, in which these comets are pictured with words implying that they were in truth the messengers of God's wrath. Again only a few centuries before, Pope Calixtus sent an army of Franciscan Friars "to pray against the Turks, and the comet, and other enemies of Christendom"—nay an old historian even relates that in response to their prayers the comet retreated (as it doubtless did) "the sword of God's vengeance being returned into its sheath." This was many many centuries after the time of David and Gad, whose ideas about the celestial apparition hovering between heaven and earth over Jerusalem were perfectly natural for pre-Newtonian times.

But singularly enough this attempt to give a scientific interpretation—historically and archæologically interesting as I think—to the very striking narrative in II. Samuel, xxiv., and I. Chronicles. xxi, has been received in exceedingly bad part by the same class of persons to whom the endeavour to give a scientific interpretation to the precisely parallel account of the Star of Bethlehem in Matthew ii., seems altogether laudable!

PICTURES.

By Baroness Von Gottrau.

"Die Kunst ist ein Spiegel in welchem sich die Zeit und die Welt abspiegeln."

IN my article in the last number of Knowledge, I remarked that the similarity between the arts of music and painting would be interestingly apparent; and, indeed, as we have the expressions of many ideas and feelings given to us through the combination and modulation of tones, so have we the same in pictures through the wonderful combination and modulation of colours. And I also remarked that in a picture the artist could actually put before us but one certain moment of an act, or one degree of an idea or feeling; yet it will not be understood by that that I mean the art of painting is inferior to that of music.

All the polite arts are great. One artist may be much greater than another; but as art means the fair execution of noble thoughts and conceptions, it will not be said here whether it be greater to execute these thoughts and conceptions in poetry, painting, music, or in sculpture.

One artist may have a more profound or more beautiful conception of a subject than another; but, at the same time, this artist may not be able to execute his idea perfectly. For instance, he may not be able to draw well, to make a correct perspective, or, perhaps, to paint flesh with a natural hue. But all these details should be perfectly executed in order to make the *ensemble* grand and effective; for to break the laws of perspective, or correctness of colour, would be as grating upon our feelings as to hear the breaking of a rule of harmony in music.

If in a picture the artist is supposed to suggest more to our minds than he has actually put before us, this then is at any rate far more difficult than in music, where

the artist begins at the beginning, and leads us with him step by step to the end.

The highest aim in Art is to represent Nature perfectly.

For instance, if a painter will make a picture representing a storm in a forest he must first of all *feel* the grandeur and beauty of the scene, and the wonder of the workings of the elements of Nature, and then he must so exactly paint every detail of this scene that we seem even to see the swaying of the branches of the trees, feel the wind, &c. : in fact every line of drawing, and every tone of colour must be so perfectly in accordance and harmony that we forget we are only looking at a picture and feel as though we are in reality witnessing the scene.

The composer of music to illustrate this same subject must likewise feel the grandeur, beauty, and wonder of it ; but then it is within his power to first describe this forest in repose, then step by step he brings on the storm ; makes us hear the thunder in the distance, then it comes nearer and nearer, we feel the wind grow stronger and stronger, the lightning breaks suddenly upon us, and after holding us in the midst of the great storm, he may, if he pleases, illustrate the ceasing of it, and leave us at last in that delightful calm and freshness which always follows the storm, with all the beauties of nature in sweet repose. I have allowed myself to give this small illustration simply to show how similar is the work of the painter and composer ; for it is in this manner that every subject—be it historic, romantic, practical, or sentimental, must be treated.

The composer of music conceives his subject, and then executes it by the many variations, modulations, and harmony of tones ; while the painter must, in the same artistic manner, execute by the perfect lines of drawing, and the delicate and exact tones, modulation, and harmony of colour.

And so, to repeat what I have quoted at the head of this article, "Art is a mirror in which time and the world are reflected." As we hear of the time when it was not known that different tones could be put together and make harmony, so we hear of the time when the old Greeks were delighted with the idea and success of one Saurias, in drawing the line of the shadow of a horse standing in the sun ; and then later, when Kore, of Corinth, drew the line of the shadow of her lover upon the wall, and it afterwards occurred to her father, who was a potter, to copy the drawing upon one of his pots.

Thus began the first illustrations in pictures, and from those quaint old drawings on vases, pots, &c., we learn of the character, customs, and ideas of the people of that time, and so on up to the present day we find in pictures, as in music, to a great extent, the history of the world and its people.

A portrait-painter has the most difficult and greatest work of all ; for as the highest aim of art is to perfectly represent nature, and man has been created as the noblest and most perfect of all things, then the highest degree in art has been attained when we see a perfect portrait of any person. But we often see a painted representation of a person where the shape of each feature may be drawn very fairly ; the shape of the head, nose, and mouth may be well represented, and the exact colour of the hair and eyes, but if all this appears flat and cold upon the canvas, with no soul or warmth of life in it, can it be called art? No ; there must be life and soul in it ; it must be *plastic*—must stand out before us in a natural, life-like manner ; we must feel the softness and warmth of the flesh, must see the soul lighting the eyes, and the expression of eyes and mouth must portray the character of the person. There must be soul in it ! Soul must speak to soul—the picture must speak to us !

There are at the present day amongst the Germans some excellent painters, and it will probably interest the readers of KNOWLEDGE to see in luxotype print some copies of some of the best and latest pictures of these artists.

In Gabriel Max's pictures we will have a very interesting study, for he has in the first place a profound conception of things, and places them before us in a most artistic and lifelike manner. There are not very many painters of the present day that can equal him in his delicate and natural representation of flesh ; and his figures are so plastic, and he possesses such an extraordinary talent for making one see and feel the relation of one thing to another.

With the editor's permission KNOWLEDGE will give with my next article on pictures a luxotype of one of Max's pictures.

München, *December*, 1885.

THE DIGNITY OF SCIENCE.

By RICHARD A. PROCTOR.

A CURIOUS question has been raised respecting the dignity of science in the pages of *Nature* and by the editor of *Nature*. The profane may be apt to think that not dignity so much as—perhaps—a different quality, is involved : for the idea underlying the theory of scientific dignity which Mr. Lockyer has advanced would appear to be that,—Your man of science ought to be incapable of anything so degrading as *work*, but to *beg* he should be by no means ashamed. The discussion, if such it can be called, arose as follows :—

Professor Odling, in a singularly able address delivered to the Institute of Chemistry, had dealt in a manly way with the necessity under which most men labour of earning a livelihood,—of maintaining themselves and their families. He had said—but I had better quote his own words :—

"The best of all endowments for research is unquestionably that with which the searcher, relying on his own energies, succeeds in endowing himself. The work to which our natures are repugnant, not less than the work which entrances us and hardly makes itself felt as work at all, has to be done. In some degree or other, we have most of us to obtain our own livelihood ; and harsh as may seem the requirement, it will, I suppose, be conceded that the necessity put upon the mass of mankind of having to earn their daily bread is an arrangement of Providence which has on the whole worked fairly well ; and further, that the various arrangements hitherto tried for exempting certain classes of men from the necessity of having to earn their daily bread, in order that they might give themselves up to the higher spiritual or intellectual life, have scarcely, to say the least of them, worked quite so satisfactorily as they were intended to. All of us are, without doubt, qualified for higher things than the mere earning of our daily bread ; but the discipline of having to earn our daily bread is, in more ways than one, a very wholesome discipline for the mass of us, and even for the best of us. It may here and there press hardly on particular natures, but it is rarely an impediment to the achievement of the highest things

by those having the moral qualities, the judgment, the determination, and the self-denial necessary above everything else for their achievement. Not a few of us may consider ourselves fitted for higher work than the gods provide for us, and fondly imagine what great things we should effect if we could only have our daily bread supplied to us by the exertions and endowments of other less gifted mortals. But experience is not on the whole favourable to the view that, the conditions being provided, the expectation would be realised. Experience, indeed, rather favours the notion that it is primarily the necessity for work, and association with those under a necessity to work,—those in whom a professional spirit has been aroused, and by whom work is held in honour,—that creates and keeps up the taste and the habit of work, whereby the vague ambition to achieve is turned to some productive account. Take, say,. a thousand of the most eminent men the world has produced, and making no allowance for the large influence of descent or training, or of association with those to whom work is a necessity, or having been a necessity is become a habit, consider what proportion of these men have, by their means and position in early life, been free from any stimulus or obligation to exert and cultivate their powers; and consider, on the other hand, what proportion of them have been stimulated to exertion and success by the stern necessity of having either to achieve their own careers, or to drop into insignificance, if not indeed into actual or comparative degradation and poverty. We ought, indeed, all of us to be students, and to be above all things students; but most of us cannot be, nor is it desirable, save in the case of a special few, that we should be only students. We have, all, our duties to fulfil in this world, and it is not the least of these duties to render ourselves independent of support from others, and able ourselves to afford support to those depending upon us. Fortunate are we in being able to find our means of support in the demand that exists for the applications of a science which has for its cultivators so great a charm. To judge, however, not indeed by their coyness when exposed to the occasional temptation of professional work, but rather by their observations on the career of others, the most sought after and highest in professional repute, the pursuit of professional chemistry is, in the opinion of some among us, a vocation open to the gravest of censure. It is praiseworthy, indeed, for the man of science to contribute to his means of livelihood by the dreary work of conducting examinations in elementary science for all sorts of examining boards, and by teaching elementary science at schools and colleges, and by giving popular expositions of science at public institutions, and by exchanging a minor professional appointment, affording abundant opportunities for original work, in favour of a more lucrative and exacting appointment involving duties which, if rightly fulfilled, must seriously curtail these same opportunities. It is praiseworthy of him to add to his means by compiling manuals of elementary science, and by writing attractive works on science for the delectation of general readers; but it is, forsooth, derogatory to him, if not indeed a downright prostitution of his science, that he should contribute to his means of livelihood by making his knowledge subservient to the wants of departments, corporations, and individuals, alike of great and small distinction, standing seriously in need of the special scientific services that he is able to render them."

I fear it must be admitted that the sarcasm of the last few lines was somewhat too unmistakably aimed at the editor of *Nature*, though this would not have been so obvious but for the circumstance that Professor Odling and other eminent men of science had been rebuked so bitterly by Mr. Lockyer for making their knowledge subservient to persons and corporations who had had the bad taste to overlook the superior qualifications of more —dignified—persons.

Naturally therefore much space is devoted to rebuking the better-known chemist. This is not done perhaps in the most open way. One is reminded rather of Koko's (or rather Grossmith's) suggestion of the individual representatives of Gilbert's types which "never would be missed." As Koko by tracing an invisible moustache here, an imaginary eyeglass there, and an imperceptible development of collar elsewhere, unmistakably indicates without actually naming the persons to whom the Bab-Ballader objects, so Mr. Lockyer by mentioning some of the best-known details of Prof. Odling's busy life, directs pointedly against him the rebukes which he is professedly directing against types.

These rebukes imply that such work as a man of science may do in the way of earning a living must not, even though the work assists the industries depending on science, interfere with higher work if higher work has been undertaken. What is the higher work does not very clearly appear. Is the determination of the position of a few lines in the solar spectrum high work? and is the application of the spectroscope to the improvement of metallurgical processes low work? Would a Dr. Huggins studying the lines of iron in the solar spectrum be an altogether dignified person compared with a Bessemer studying spectra in his iron-works? and what position would then be assigned to a third person Mr. Lockyer, for instance—who should patent for his personal benefit a process which he thought likely to be useful to metallurgists?

For my own part I find such discussions as these, at least from Mr. Lockyer's standpoint, altogether wanting in dignity. I hold with Professor Huxley that a man of science should regard himself as a citizen in the first place, a student of science in the second (if in so high a place). Whether a man who deems himself capable of enlightening the world but is unwilling first to maintain himself and his family, acts like Palissy, letting wife and children want and run the risk of actually starving while he throws the last stakes in his gambling venture for fame and wealth, or whether he sickens his fellows by begging unceasingly for State alms, he equally—in my judgment—degrades research, if he does not disgrace manhood. I think far better of the man who like Mr. Lockyer, as pictured without being named by Professor Odling, and Professor Odling, as pictured without being named by Mr. Lockyer, earns money for himself and his family by work in which scientific progress in one form or another is held in view.

Of course we can sympathise with those who believe that they could do more useful work were they not thus obliged to give so much time to the higher duties of the citizen, the husband, the father; and we may rightly feel wroth with men who, having ample means and perhaps no family dependent on them, leave their powers unused (as, alas, Newton did from the time when a well-paid post was given him). But men sometimes misjudge their powers, and are really doing more good in what seems to them inferior work than they could have done (to say nothing about what they would have done) if freed for higher researches. And as to the balance between the sense of duty in regard to research on the one hand and in regard to family on the other, there should be no question. The student of science who, as years

advance, looks back at his own career, is more apt—if he is conscientious at all—to feel the reproach of conscience for time given to advance scientific knowledge which should have been devoted to his family, than for labours directed to the well-being of his family when he might have been advancing scientific knowledge. And this point of conscience really settles the question of dignity; for a course can never be consistent with dignity which is contrary to the dictates of conscience.

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

COLOUR AND LIGHT.

IN speaking of the ultimate constitution of white light on pp. 48 and 49, we said that in decomposing a beam of solar light by the aid of a prism into five distinct bands of colour, we had "not even yet reduced our spectrum to its lowest terms." Let us endeavour to ascertain how much farther we can simplify it.

Every possessor of a paint-box knows how very few paints are really needed to represent—at all events approximately—the majority of colours we meet with in nature. Suppose, for example, that we are restricted to carmine, Indian yellow, and Prussian blue. The carmine and the Indian yellow, mixed in various proportions, will give us a series of oranges and orange-reds; the Indian yellow and the Prussian blue a large range of greens: while all sorts of violet and purple hues are obtainable from varying mixtures of Prussian blue and carmine. This, the employment of an impure spectrum. *i.e.*, one mixed with white light, and some misunderstood experiments with absorptive coloured media, induced Sir David Brewster to propound the theory in his work on "Optics" in "Lardner's Cabinet Cyclopædia" (pp. 72 *et seq.*), that white light has in reality but three primary constituents—red, yellow, and blue. He announced this in the work just cited as an original and independent discovery; but he had been long anticipated in his doctrine of the triune character of light, first by Wünsch at Leipzig in 1792, and not long subsequently, at the beginning of the present century, by that truly great philosopher and physicist Thomas Young, in this country. Nay more: so far from Brewster having made a discovery, he absolutely enunciated an erroneous doctrine, and took a retrograde step in comparison with those of his predecessors. It is quite true that the light of the sun, as it reaches us, is compounded of three colours, and of three only; but unfortunately two out of Brewster's three colours happen to be the wrong ones! For while it is the veriest truism to assert that blue and yellow *paint* mixed together form green, no such result can be predicated of the mixture of blue and yellow light; which mixture, so far from being green, is white. These colours are, in fact, complementary to each other. Helmholtz has explained how it is that blue and yellow pigments produce green by admixture. If we make solutions of, say, Prussian blue and gamboge, we do not obtain a pure blue, or a pure yellow. In the former case a quantity of green light gets through with the blue; as in point of fact, it does with the yellow light too. Then supposing that we mix such a blue and yellow as this, the blue will cut off the yellow, the orange, and the red end of the spectrum; and the yellow will similarly obliterate the blue, indigo, and violet end. We have seen, though, that both are transparent to green, so that when white light passes through a mixture of blue and yellow paint, or through superposed blue and yellow glass, the green alone reaches the eye. Furthermore, if we carefully select colours of the proper degree of refrangibility, and paint discs with them, causing the light reflected from these discs (by a contrivance to be immediately adverted to) to reach the eye simultaneously, by no artifice whatever shall we succeed in producing a green hue, or, in fact, anything but a greyish white. The fact is, as we shall see by and bye, that the three primitive colours are a scarlet red, emerald green, and violet blue, or blue violet.

For the purpose of compounding coloured lights, what are known as "Maxwell's discs" (from their inventor, the late lamented Clerk-Maxwell) afford considerable facilities. They are simply circular discs of white cardboard, as

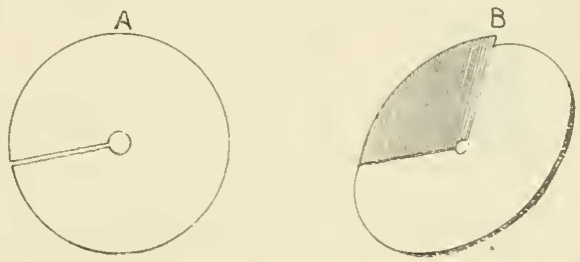


Fig. 6.

shown in Fig. 6, A, each furnished with a radial slit which enables two or more of them, each being painted of the required colour, to be superposed on the spindle of an ordinary whirling table. B in the figure shows two of these discs as being partly superposed. A glance at the figure—or, better still, the cutting out of two such discs, will show how the proportion of any given colour to any other can be obtained by simply twisting one of the discs round its own centre. The whirling table scarcely demands description here; but we may mention that the one employed by ourselves for the purposes of this series of papers consists of a base-board 36 inches long, 8 inches wide, and ⅝ inch thick, at one end of which a grooved wheel 9 inches in diameter rotates on a vertical spindle, and, by the aid of a piece of fine cord, drives another small vertical spindle at the other end of the board, the last-named one carrying the discs which we have just

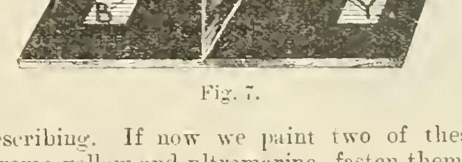


Fig. 7.

been describing. If now we paint two of these discs with chrome yellow and ultramarine, fasten them on our spindle and set them in rapid rotation, we may vary the area of blue or yellow respectively in any proportion we please, but we shall never obtain any resultant tint in the smallest degree resembling green.

Another simple piece of apparatus for mixing coloured light is shown in Fig. 7, and may be bought at any of the so-

called "novelty shops" in London. Its primary purpose is to teach drawing by enabling a child to trace on paper behind a reflected image. It is, however, equally useful for our present purpose. It consists of a thin flat base, from which rises centrally, and at right angles, a plate of glass, G. The base must be blackened with a dead black, either by pasting a piece of such paper over it, or by painting it with lampblack and size. If now we place a piece of coloured paper (say blue) at B, and another (suppose yellow) at Y; then, the eye at E will see the former directly through the glass and the latter by reflection seemingly superposed on it, in a way which our figure above will render immediately intelligible. If it be desired to vary the brightness of the image, this may be effected by moving the bits of coloured paper further apart or nearer together as the case may be.

Fig. 8.

Yet another and very effective method of mixing coloured light is shown in Fig. 8, when C is a piece of black cardboard in which two circular holes are punched with an ordinary gun-wad punch, with an interval of $\frac{1}{8}$ inch or so between their peripheries, and then are covered with thin sheets of gelatine of the required hues—let us say in this case red and green. P is a common "double image prism," purchasable of all dealers in polarising apparatus. The familiar effect of this is, of course, to duplicate all images, and so cause an apparent overlapping of the colours, the prism being rotated until superposition occurs and a sufficient area of the combined lights becomes visible. Should we chance to hit upon the two proper colours, the overlapping portion will approximate to white. We shall, though, most probably find that it will be yellowish or orange, thus definitely exploding the idea of Sir David Brewster that yellow is a simple colour. Or, again, by the aid of two magic-lanterns such as are used for dissolving views (and preferably illuminated by the electric or the lime-light), we may superpose the images of two coloured discs of gelatine upon a white screen, so as to exhibit to a large number of people at once, in a most striking and instructive form, the effect of the mixture of the primary spectral colours. Lastly, by a very simple little artifice we may mix the colours of the spectrum themselves. All we have to do is to cut two very narrow slits in a black card — or, perhaps preferably, a sheet of latten-brass—as shown in Fig. 9, and view them through a prism whose edge is parallel to their length, from a distance of a yard or so. It will easily be seen how and why the spectra will overlap. It is needless to add that the train of prisms in a "direct-vision" spectroscope exhibits this effect in a much more striking form. We would earnestly urge on the student the necessity of repeating every one of these experiments for himself. He will thus realise their import in a manner wholly unattainable from the mere perusal of our descriptions. Whichever of the modes just described we adopt for combining coloured lights, we shall find that red, mixed with greenish blue, orange and a greenish blue, bright blue and bright yellow, and greenish yellow and violet light, when mixed in the pairs indicated, all four give white light as a result. In the case of Maxwell's discs, the resulting hue is always more or less grey, rather than white. The origin of this lies in the difference of luminosity of the two colours, and it is quite possible upon a few trials accurately to imitate the very pale grey furnished by (say) a pair of blue and yellow discs, by means of a properly proportioned black and white pair alone. Now it was upon researches into this elementary constitution of light that Young founded his famous theory of vision, more recently adopted and expounded by Helmholtz. He supposed that each element of the retina of the human eye (Fig. 1, p. 16) possessed the capacity for transmitting three kinds of sensations; or, to put it in another way, each element was entered by three fibrillæ of a nerve, one of which vibrated to, or was excited by, red light, the second in like manner by green light, and the third by violet light. It would be more rigidly correct to say that these fibrillæ are *principally* excited by light of the colours named, respectively; since Young conceived that what we may call the red nerve fibril is very feebly responsive to green and violet waves as well; the green fibril to red and violet waves, and the violet fibril to red and green waves; albeit the overwhelming part of their excitation proceeds from those colours alone to which each is more especially adapted. When the three sets of nerves are equally excited we experience the sensation which we call white. When the set most sensitive to the least refrangible rays is excited, we see red; when the nerves affected by the middle of the spectrum are set in motion we see green; while the nerves most susceptible to the most refrangible end of the spectrum when excited give us the sensation of blue or violet. As far as the mammalia are concerned, dissection of the eye has, so far, furnished no corroboration of this theory; but Max Schultze actually has discovered in the eyes of some birds and reptiles, among the rods of the retina many which contain a drop of red oil at the end fronting the cornea or which is turned towards the light; while other rods contain a yellow drop, and others none at all. It is not difficult to see the bearing of this on the theory of Young and Helmholtz. Now assuming this theory to be correct, let us see how it explains the production of the sensations of single colours by the mixture of two others. In the ordinary spectrum (Fig. 2, p. 16) yellow lies between green and red; hence a mixture of red light and green light ought to produce the sensation of yellow light by stimulating what we have called the red nerves and the green nerves. This may, perhaps, be most successfully effected in the modes illustrated by Figs. 8 and 9 above; but a very tolerable though somewhat dingy yellow is producible by the combination of two of Maxwell's discs (Fig. 6) coloured with emerald green and vermilion respectively, and set in rotation on the spindle of a whirling table. We have said that the resulting tint will be that of a "dingy yellow"; nor is the reason far to seek; the chrome yellow, Indian yellow, or Cadmium yellow of our paint-boxes are very much more luminous than our vermilion, carmine, emerald, or sap green, and it is obviously impossible, to use a homely form of phraseology, to get more luminosity out of a combination of coloured discs

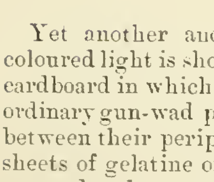


Fig. 9.

than you put into it. Pretty evidently, then, the total luminosity of the spectral coloured disc produced by rotation will be the mean of the luminosities of its two painted components. Suppose now that we diminish the intensity of our green light, then will the yellow produced by its combination with the red become orange, passing as such diminution progresses through red-orange and orange-red to pure red. It will be at once inferred that if we, on the other hand, diminish the intensity of the red component, the resulting colours of the combination will pass through greenish yellow, yellowish green, and so to pure green. Similarly, by mixing green and violet light, we shall produce the whole range of blues, and so on. We have said above that, while the theoretical three sets of nerves are to a very great degree respectively sensitive only to the three primary colours—red, green, and violet—yet that each is also affected slightly by the two remaining colours not specially pertaining to it. Hence, under ordinary circumstances, a very small quantity of white light must be mixed with every colour we perceive, diminishing to that extent its intensity or saturation. And that this is the case even with the colours of the spectrum a simple experiment, devised and described by Helmholtz will suffice to show. We can tire a nerve just as we can tire a muscle. If we go out into the bright sunshine, and then enter a darkened room, for some time we can see nothing at all. Our retinal nerves are so fatigued with the glare of the sun as to be absolutely insensible to the faint light reflected from objects in our dimly-lighted chamber. By and bye, when the eye becomes, as we say, accustomed to the darkness, we can see perfectly, and even read, where on our first entry nothing whatever was visible. On a cognate principle, if we stare at a brilliantly-lighted church window for a minute or so, and then turn the eyes towards the grey wall, we shall see an image of the window of the identical size and form of the original, but with white for black and black for white, like the negative of the photographer. The glare of the light transmitted through the glass has tired out the retina, and those parts of it upon which that glare has fallen are less sensitive to the light reflected from the grey wall than its other portions, hence there appears the dark image of the window-panes upon the uniform surface. Thus much in preliminary explanation of the experiment of Helmholtz, who gazed upon bright bluish-green until he quite tired out his retina as far as that colour was concerned, making himself, in fact, practically green-blind and violet-blind. Regarding now the red of the spectrum, the after-image of the bluish-green appeared of such a burning and effulgent red that the adjacent red looked actually whitish in comparison! We shall have something more to say of coloured "ghosts" in a future paper in connection with the subject of complementary colours. We shall see too how indefinitely our range of colours producible by mixtures of the three primary ones, is extended by mere changes in luminosity. For the present, what we have here said must suffice.

THE STORY OF THE HEAVENS.*

THIS is a most disappointing work. We opened it rejoicing in the thought that now at last we had a volume which we could name in answer to the multitudinous inquiries of young students for a really trustworthy and at the same time interesting and instructive treatise on astronomy—yet with some misgivings that as in other cases where surveying astronomers had attempted the work of astronomical teaching a rather dry and uninviting book might have been produced. But our disappointment has been more complete than this natural fear suggested as possible. The book before us has little interest in the way of descriptive astronomy, its supply of solid food is of the most indigestible sort, and the theoretic and speculative matter is not only very questionable but relates to subjects of very little interest.

One or two examples of Dr. Ball's method in description and in explanation will be fairer than mere verbal criticism. As to the theoretical matter we note that beyond Tschermak's theory of meteoritic origin (unsoundly limited to ejection from the earth), and the theory of the moon's origin from earth-waves (which the time-element negatives, as here advanced) there is little to attract attention.

Here, then, is the description of those most interesting of all celestial objects the rings of Saturn :—

"The various features of the rings are well shown in the beautiful drawing of Trouvelot. We here see the inner and the outer ring, and the line of division between them. We see in the outer ring the faint traces of the line by which it is divided, and inside the inner ring we have a view of the curious and semi-transparent crape ring. The black shadow of the planet is cast upon the ring, thus proving that the ring, no less than the body of the planet, shines only in virtue of the sunlight which falls upon it. This shadow presents some anomalous features, and its curious irregularity may be, to some extent, an optical illusion. The drawing contains no trace of those other and finer lines which are more or less problematical, but it is a faithful representation of the planet, under good seeing conditions, and viewed in a telescope of considerable power. There can be no doubt that any attempt to depict the rings of Saturn can only represent the salient features of that marvellous system. We are situated at such a great distance that all objects not of colossal dimensions are invisible. We have, indeed, only an outline, which makes us wish to be able to fill in the details. We long, for instance, to see the actual texture of the rings, and to learn of what materials they are made; we wish to comprehend the strange and filmy crape ring, so unlike any other object known to us in the heavens. There is no doubt that much may even yet be learned under all the disadvantageous circumstances of our position; there is still room for the labour of whole generations of astronomers provided with splendid instruments. We want accurate drawings of Saturn under every conceivable aspect in which it may be presented. We want incessantly repeated measurements of the most fastidious accuracy. These measures are to tell us the sizes and the shapes of the rings; they are to measure with fidelity the position of the dark lines and the boundaries of the rings. These measures are to be protracted for generations and for centuries; then and then only can terrestrial astronomers learn whether this

* "The Story of the Heavens," by Rob. S. Ball, Astronomer-Royal of Ireland. Cassell & Co., London, &c.

elaborate system has really the attributes of permanence, or whether it may be undergoing changes of marvellous rapidity, when the gigantic nature of the objects involved is considered."

It appears to us that the average reader can easily see, for himself, the features mentioned in the first part of this descriptive (?) passage; and half a page devoted to an account of what the reader would naturally like to know, but cannot yet be told, is just half a page wasted.

We had proposed to quote a passage illustrative of Dr. Ball's explanatory method, but we really have not space. Take, for instance, transits of Venus:—On p. 143, he tells in a paragraph of half a page that there are such and such bodies in the solar system (which the reader already knows from the book itself); in another, equally long, that we cannot fully understand a map unless we know its scale; in a paragraph of three-fourths of a page that one can make a plan of the solar system without knowing its scale. (In the body of this paragraph is a sentence quite out of place, repeating that transits of Venus will give the scale of the solar system.) One-third of a page shows that when Venus is passing between us and the sun she may be seen on his face. But we learn in two-thirds of a page that she may not, because her plane of travel is inclined to the earth's.* So on and on for page after page—the only attempt at the explanation of the actual transit problem being contained in a paragraph pointing out that if one changes position in a room the window-bars change in apparent position on the distant landscape, followed by remarks showing that the same sort of thing must happen with Venus on the sun. Not one definite statement is made as to dimensions, durations, or the like. (In the earlier and still more general account there are several inaccuracies; for instance, we are told that "the remarkable eight-year period *necessitates*" that a transit in any year shall be followed by another eight years later, which is by no means the case.) Then the old story of early transit observations is repeated—quite properly, of course—after which four pages are given to an account of the observations at the Dublin Observatory during the transit of Venus in 1882, made under very unfavourable conditions and without anything of the least importance being noticed. After, in all, seventeen pages, scarcely containing half a page of real matter, Dr. Ball remarks that it is not possible for him, "with a due regard to the limits of this volume, to linger any longer over the consideration of the transit of Venus." But further Dr. Ball persists in lingering. "When we begin to study the details of the observations we are immediately confronted with a multitude of technical and intricate matters. On the occasion of a transit, it has first to be decided where the observations are to be made —in itself a question that has led to no little discussion. Then the instruments that are to be used, and the description of observations to be made, have to be investigated with considerable complexity. The observers must be specially trained for the work, for even Methuselah himself could hardly have lived long enough to have had much *practice* in the observations of transits of Venus. To compensate for the inevitable want of experience, the observers had to be prepared by a special course of instruction, in which a fictitious transit was observed. Then, too, the interpretation of the observations involves many thorny and many controverted questions. To pursue all these matters so as to render them intelligible, would lead us into great detail and therefore we do not make the attempt. This course (*sic*) is the more advisable when it is remembered that the transit of Venus is only *one* of the methods of finding the sun's distance—a celebrated one, no doubt, but not perhaps the most reliable. It seems not unlikely that the final determination of the sun's distance will be obtained in quite a different manner. This will be explained further on," "and hence we feel the less reluctance in passing away from the consideration of the transit of Venus as a method of celestial surveying."

Dr. Ball is a powerful mathematician, an able and doubtless faithful observatory chief; but he has not done his readers or his publishers justice in the book before us. We are not to know on what terms, generous or the reverse, this book has been written; but for his own credit's sake Dr. Ball ought not, we conceive, to have devoted page after page, in the style we have sampled, to tell his readers that he is unable to tell them what the student of astronomy would naturally like to learn. Those students whose inexperience leads them to imagine as they read page after page of such nothings, that they are following explanations and gaining information, have not been quite fairly treated.

* Two-thirds of a page, and more, might quite reasonably be given to *elucidating* this point; but Dr. Ball does not elucidate it at all. Here is a part of the passage, (the bulk is like the sample):—"If it should happen that Venus overtakes the earth at or near either of the points (!) in which the plane of the orbit of Venus passes through that of the earth, then the three bodies will be in line, and a transit of Venus will be the consequence. The rarity of the occurrence of a transit need no longer be a mystery," &c. A figure showing what is meant, and definite reference to the positions referred to in the description, would have occupied no more space than the paragraph, and would have been far more instructive.

NEWTON, HIS NAME AND FAME.*

IT may be reasonably questioned how far we have any right to inquire into the private life of those from whose thoughts or labours we have profited. That the private lives of kings and queens and other such persons (who are thought to do well when they do no particular mischief) should be inquired into, is right enough; for the nations do not profit by them, and they cost a good deal; so that in their case the world has rights for which it has paid more than a fair equivalent. But the case is otherwise with the great.

There can be no doubt, however, that if accounts are given to the world of the lives of men like Bacon and Newton, Shakespeare and Milton, Priestley, Davy, and Faraday, such accounts should be carefully freed from all that is false or misleading. It is bad enough to pry into the private lives of such men at all; but certainly it is much worse to spread untruths about their lives, even though this be done through mere carelessness; and it is worse still if falsehoods are spread wilfully.

We are glad, therefore, to see that the inquiries made by the late Professor De Morgan into details of the life of Newton have been at length published. For undoubtedly the present work will serve to clear up certain points which were left in doubt after the publication of Sir David Brewster's later and larger book on Newton.

De Morgan devotes the greater part of this work to the matter of Lord Halifax and Newton's niece. The enemies of Newton and even some who—like Voltaire—were genuine admirers of his genius, adopted the belief that Miss Barton was Lord Halifax's mistress. Sir David Brewster and others who have simply sought to clear Newton at all hazards, have endeavoured to show

* "Newton: his Friend and his Niece." By the late Augustus De Morgan. Edited by his Wife, and by his pupil, Arthur Cowper Ranyard. London: Elliot Stock.

that Miss Barton never lived in the same house with Halifax. Lord Macaulay and others have advanced the idea that Miss Barton's relations with Halifax were akin to those of Mrs. Unwin with Cowper, and of Mrs. Bracegirdle with Congreve. De Morgan maintains the theory that Lord Halifax and Miss Barton were privately married. It appears to us that De Morgan has fairly made out his case. Sir David Brewster's theory is simply absurd on the face of it, as is indeed Brewster's position generally in regard to Newton. Probably no biographer has ever in an attempt to defend a great man through thick and thin, done more to injure his reputation than Sir David Brewster has done to injure Newton's, by fatuous attempts to deny what is shown by the clearest possible evidence to have actually happened. No one probably believed that Newton had consented to profit by the degradation of his niece, until they found Sir David Brewster denying flatly what was well-known and admitted in Newton's lifetime. It is certain that Miss Barton lived in the same house with Lord Halifax, that her association with him whatever its nature was greatly valued, and that for this reason he left her at his death a large sum of money and a valuable house. It is also certain that he had already bought for her an annuity which in those days amounted to a handsome income, Newton acting as his agent in the matter. Nothing in all this would seem suggestive of evil to those who (being themselves of honest mind) recognise the quality of Newton's nature—far from being perfect but free from inherent vice or depravity. So soon, however, as Sir David Brewster attempted to deny these demonstrated facts, even the most zealous admirers of Newton, the most honest believers in his purity, began to fear that after all Newton *must* have trafficked, as Voltaire had openly suggested, in his niece's shame.

The real fact is, however, that Newton *was* blameworthy, though in small degree. Sir David Brewster had gone far to bring utter opprobrium on his hero by trying to deny that he had done aught amiss. Brewster had actually written to De Morgan that, as Newton's biographer, he would at all hazards deny what would seem reprehensible in Newton,—"every means of defence against such an hypothesis" he says, speaking of Newton's real weakness in the matter, "becomes obligatory on me as his biographer,"—which indicates about the most foolish idea a biographer could possibly entertain.

De Morgan shows that in all probability, almost certainly in fact, Lord Halifax and Miss Barton were man and wife, and that this was known within a small circle of relatives and friends. That Newton's suffering his niece to lie under the stigma of imagined concubinage when really married, would not be thought a grave offence or even an offence at all in those immoral times, is clear enough, whatever some ignorant folk ("clergymen and persons of rank" he says) may have told Brewster to the contrary. That Newton himself knew that he owed more faithful guardianship than this to his niece, can hardly be doubted. He was blameworthy, no doubt, but not guilty of the foul offence which Sir David Brewster's fatuous defence had seemed to bring home to him.

That Miss Barton was married to Lord Halifax is shown by his own continued respect for her, and the esteem in which all held her who knew them both; by the tone of the Montague family towards her and Newton after Halifax's death; and by many collateral circumstances.

More important, though occupying less space, is De Morgan's discussion here of several points connected with Newton's scientific career. He takes a fair view of Newton's character, neither attributing to him, as some have done, the whole discredit for the acrimonious dispute with Flamstead, nor acquitting him, as has still more unwisely been attempted, of all blame there or elsewhere. Newton was unquestionably a man of jealous and suspicious temperament, capable of occasional meanness as all such men must be, but controlling his own nature for the most part with such care as to deserve more credit than would have been due to him had he inherited an easier nature. His zeal for science was not great enough to urge him to laborious research after he had made his name great, and had gained, besides fame, a lucrative post. His career affords, in fact, the strongest proof of the folly of those who imagine that science can be effectively advanced by endowment; for from the time when his lines were made easy by a lucrative appointment, by no means taxing his time or energy in such degree as greatly to diminish his opportunities for original research, Sir Isaac Newton did nothing for science. *We owe to endowment, in Newton's case, the loss of all that that wonderful mind could have done during the best part of a lifetime.*

Gossip.

By Richard A. Proctor.

It should be clearly understood by this time that if readers send cheques, stamps, instructions, and so forth, to the editor of Knowledge—*i.e.*, to me, Richard A. Proctor—instead of the publishers, they give a great deal of useless trouble, and they incur the risk of remaining unattended to. The publishers receive an immense number of letters, and have to sort out those belonging to the various editors, authors, contributors, &c., of the different magazines, works, &c., published by them. Here is risk No. 1: a letter intended for Knowledge editor *may* (though the chance is slight) be sent to some one else, and not reforwarded. Then, next, letters for the editor of Knowledge still come in in great numbers. Hence risk No. 2; among the multitudinous letters he receives, nine-tenths of which might as well not have been written, the editor may chance to overlook (especially now that he does not give a column of replies) the one which contains a business letter. (I found one the other day in a book sent for review.) Then comes risk No. 3. Such business letters are put on one side to be forwarded to the publishers. But the editor travels about a good deal. (He will have given twenty-nine lectures for example at "all sorts of" places during the four weeks ending December 20.) It is always possible, in the midst of constant travel, lecture arrangements, lecture correspondence, &c.—combined with book-writing and correction, preparation of new editions, essay writing, study, correspondence, exercise, occasional attempts at relaxation (a mere detail, perhaps), and some few moments passed in association with his family,—that letters thus set aside to be sent to the publishers may be mislaid, or lost in what the late Abbé Moigno pathetically described to the editor as the "bottomless sea of papers and letters." If delay or loss should arise in that way the editor is apt to be energetically abused. He ventures to point out that considering the multitudinous instructions given during more than four years on this point, it is he who—were he not a

long-suffering sort of a fellow—should do the abuse,—not get it.

* * *

Similar remarks apply to manuscripts. Those who send unsuitable manuscripts, bearing no address (address in accompanying letter is useless) and without stamps for return, expecting that when, perhaps three months later, they apply for their MS., it will of course be forthcoming, prepare for themselves sure and certain disappointment.

* * *

I have received from several well-meaning persons, letters begging that I would avoid all remarks such as those upon Dr. Payne Smith's commentary on the Book of Genesis, and keep carefully out of Knowledge all such writings as Mr. Clodd's "Story of Creation," my own "Science of Religion," and Mr. Allen's charming evolutionary papers, and in fine so far as I can judge, everything which would not have been thought fit for young children fifty years ago. Some who write thus, give as the reason likely to be most effective, their impression that Knowledge would have a much wider sale if its pages were thus specially fitted for the nourishment of babes and sucklings.

* * *

Now I prefer it to be thoroughly understood that the tone given to Knowledge depends solely upon my sense of what is best. Knowledge endeavours to show that the teachings of the science of our day are not subversive of religion, however corrective they may be of religionism. The children in a Sunday-school, or young girls in a seminary of the conventual type, would of course not be benefited by passing suddenly from the simple teachings which have suited them to those which the more advanced require. But this is so only in the sense in which the lessons of the Differential Calculus (for example) are unsuited to the boy who is advancing from Addition and Subtraction towards Long Division. One might reasonably urge that a statement respecting "Taylor's Theorem" would be confusing to Johnny Noakes or Polly Styles, subtracting 17 from 51, and perhaps getting 23 for the difference. But a treatise on the Differential Calculus is not meant for those young and as yet not very intellectual persons. And the Differential Calculus is not only not inconsistent with all that is true in Subtraction or Multiplication, but emphatically requires that these processes shall be true and truly effected (that the taking of 17 from 51 shall leave 34 and not 23).

* * *

I cannot keep out of these pages Mr. Williams' account of coal because it is not a description of the domestic fireplace, nor "F.R.A.S."'s optical papers because they do not tell us that the fields are green and the skies blue, or Mr. Allen's essays because he does not tell us such things as we used to find in Mavor's Spelling-book, nor Mr. Clodd's because his Story of Creation is not that which in the childhood of the human race seemed all that was necessary to be known or suggested as perhaps possible. If it is the case, as no doubt it is, that there are many more ill-informed and child-like persons in the community than there are of those who know more and think at least a little, then so much the smaller for the present is the community for whom we work. But most assuredly we are not going to pretend to write for the community of thinking persons, and in reality to supply matter only for those who mentally and morally are but as children. It is no doubt a most desirable thing that these should be taught; but we have undertaken other work.

* * *

A new interpretation may be suggested for what was said of old, "Let the dead bury their dead,"—to wit, let those who give their best energies to the study of the dead languages bury their dead beliefs under them. Albeit this must be limited to those who make that study the end of their work: those who study the dead languages of the Assyrians, Egyptians, and so forth, that they may interpret better the histories and the thoughts of ancient races, are doing most important work.

* * *

It is rather amusing to contrast two remarks in last month's Knowledge, one by Mr. W. Mattieu Williams, the other by Mr. Clodd:—

Says Mr. Williams, "Modern scientists who discuss dogmatically the properties of imaginary entities should be warned by the fate of poor old phlogiston or fire-ether, and study its philosophical analogy to the luminiferous ether."

But Mr. Clodd remarks that for the explanation of certain "varied and yet related phenomena, it is a necessary assumption that the minutest intervals between atoms, as well as the awful spaces of the universe, are filled with a highly rarefied, elastic medium called ether, which, ever tremulous with unentangled vibrations, is the vehicle of energy, alike from the infinitely great and the infinitely small."

* * *

In reality, Mr. Williams overlooks the real analogy, which is between the ray theory of light and heat and the poor old phlogiston. It was the old theory of the emission of something real in the form of rays, a theory which, wrong though it was, found favour with Newton and other distinguished men, which might fairly be compared with the idea of phlogiston. The theory that heat and light are modes of motion, which displaced the idea that they are actual substances, required that they shall be regarded as traversing interplanetary and interstellar space (as they unquestionably do traverse such space), by vibrations in *some* medium,—and the ether is simply what we call that medium. No "properties" have ever been assigned to that ether, either dogmatically or otherwise, except such properties as we recognise from the manner in which vibrations pass through it. In all that science has asserted about ether she is on absolutely sure ground, because every one of these properties may be tested, and has repeatedly been tested, experimentally.

* * *

Mr. Williams has selected for attack one of the assumptions of science which has been advanced and maintained in the most purely scientific spirit. Assumed to interpret the peculiarities of a most complete and complex series of observations, the theory of an ether has been tested in every conceivable way, even to the calculation of what might be expected under new conditions, (sometimes of the most complex character)—and invariably the theory has been confirmed. The old theory of light which the vibration theory replaced failed early, or the theory of a luminiferous ether would scarcely have been entertained; but if that older theory had not failed then, the phenomena of diffraction and polarization would have sufficed to kill it thoroughly. I cannot imagine that any one acquainted (understandingly) with even the elementary parts of the mathematical inquiry into the wave-theory of light, can question any of the

properties which have been necessarily assigned to the ether of space.

* * *

The idea that because we cannot actually analyse physically or chemically some particular entity (whose very nature may place it outside such analysis) we therefore must not admit its existence, is altogether unscientific. (In Mr. Williams's case there is I know the belief in highly attenuated air to conflict with the acceptance of ether—an excuse though not really a reason: but I do not care to remark upon his attenuated air theory beyond saying of that air that it is *too* thin.)

Consider the following example:—

There is a bowl of glass which we know to be such because we can study its outer surface; but we cannot examine its interior, nor test its weight, because it is fastened by some rigid support. We move so that a light is seen through the globe, and then moving the eye sideways find the light draw near the edge in *the same direction*, but never actually reach the edge: we are now justified in assuming that the globe is only a shell of glass with air or some other medium much rarer than glass inside. This assumption is absolutely sound, in this general form. More careful observation may enable the mathematician to say just how thick the glass shell is, and just what refractive power the medium inside possesses. Supposing this refractive power to be that which air at the average sea-level pressure possesses, the observer might infer with considerable probability that there was air within the shell. But on this point he could not be certain; for other gases than those in air might at certain pressures have the same refractive power.

* * *

Or "put it my juvenile friends," as the unctuous Chadband hath it, that our observer on moving his eye to the right found the light pass off to the left, until, moving continuously but not uniformly to the left (as his eye moved uniformly to the right) it came right up to the very outline of the disc presented by the bowl. Then he would be justified in inferring that the bowl was not a mere shell of glass, and that, if not a globe of uniform glass throughout, its interior varied continuously in density, not by any sudden or abrupt change as from water to glass. If he found the final direction of the light when seen on the very verge of the disc to correspond to the direction due to the refractive power of glass of the same quality as the tested outside of the globe, he might infer with considerable probability that the globe was throughout of the same material. But this would not be absolutely certain.

* * *

If, however, he found that while his eye moved uniformly to the right the light moved continuously up to a certain distance from the edge of the disc presented by the bowl, then became indistinct for a moment, and presently was seen nearer the edge and eventually came right up to it,—then the observer would be justified in assuming that there was a shell of glass, enclosing a medium of somewhat smaller refractive power, as water, for example. He might be able to determine observationally the precise thickness of the glass shell; and further, assuming that the medium within was really water, he might, by a series of observations, test this assumption. If he found that the medium certainly was not water, and had not the refractive power of any substance he had tested, it would still be a demonstrated fact that there was some medium of such and such refractive power within the shell.

* * *

In like manner it is a demonstrated fact that there is a luminiferous medium, possessing such and such properties,—but its actual nature not wholly determined or probably determinable. To dogmatise as to the undetermined properties of this ether would be an unscientific proceeding; but to doubt the demonstrated properties is to indicate want of power to appreciate the investigations (certainly rather recondite in parts) by which these properties have been ascertained. Precisely so, to take a much easier subject, an imagined student of our illustrative bowl would not act as a scientific man should, if he assumed in the third case that the enclosed medium, as yet undetermined, had such and such chemical properties; but for him to doubt its refractive power would simply indicate his inability to understand the laws according to which rays of light pass with refraction, from all but tangential contact *into* a spherical glass shell, full of a medium nearly as refractive as itself, and thence tangentially *out* of it.

* * *

Of course inability to understand such a simple experiment as this (the reader can readily try it with a globular decanter—or a tumbler will do—first empty, then full), and inability to follow such difficult mathematical calculations and such delicate physical experiments as have been used to establish the undulatory theory of light and to demonstrate the general qualities of the luminiferous ether, are very different matters: but the principle is the same.

* * *

The advocates of the "poor old theory of phlogiston" opposed, through precisely such unreadiness to admit the force of evidence, the introduction of the theory that heat is not a substance but a mode of motion. So did the advocates of the emission of some actual matter in rays oppose the undulatory theory of light. But their objections remain now merely "to point a moral or adorn a tale."

* * *

On the other hand, I do not feel quite so clear that my friend Mr. Clodd has been well advised in giving new definitions and altered meanings to the much misused words Force and Energy. Of course, as he does define, very precisely, the sense in which he proposes to use the words, the reader of his thoughtful essay need not care to consider whether the words *should* be so understood generally or not. In the well-known story of the undergraduate under examination who had in a descriptive answer written throughout of seven somethings (I forget what) where, as he remembered towards the close he should have said five, that ingenious examinee to save the trouble of going through his reply and correcting every "seven" into a "five," made all right by prefixing this note, "In the three following pages let the symbol 7 represent 5, and let the word "seven" represent the word "five." So, but with intention aforethought, Mr. Clodd, at Mr. Allen's suggestion, gives meaning to his remarks about Force and Energy by explaining at the outset that in what follows the word "Force" stands for something akin to what is ordinarily called "Attraction," and the word Energy for "Repulsion." All the reader has, then, to consider is whether the statements so understood are correct. It is to be feared, perhaps, that the confusion which has appeared in certain important philo-

sophical essays between the "Conservation of Energy" and a property—unknown (at least as a general property) to exact quantitative knowledge—entitled the "Persistence of Force," may fail to be cleared up when new meanings are given to the words Force and Energy; but perhaps that difficulty may be avoided.

* * *

SPEAKING as a student of mathematical mechanics, to whom the constant use of words in the same meaning is of some importance, I may note here that in the mathematically mechanical sense Force and Energy are quite distinct. Whatever causes or changes motion we call *Force;* the effects of Force we call *Work;* and *Energy* is stored *Work,* whether in change of position or in generated motion. The word *Power* is used only in relation to mechanisms.

* * *

THE fulfilment of the prediction made in November, 1872, with regard to Biela's comet, and the occurrence of yet another display of meteors following in the track of that comet on November 27th last, must have removed all possibility of doubt as to the actual connection between the meteors of November 27, 1872, November 28, 1878, and November 27, 1885, with the divided and eventually dissipated comet which appeared in 1826, returned in 1832, 1839, 1846, 1852, 1859 possibly, but not in recognisable form in 1872, 1878, and 1885 as it would but for disintegration.

* * *

IN discussing the movements of the meteors seen on the night of November 27th, some members of the Astronomical Society touched on the theory—quite inadmissible, it seems to me,—that Biela's comet and meteor stream may have been ejected in remote times from the earth in the sunlike state. Say Jupiter, and the idea is likely enough.

* * *

OUR contributor who prefers "Bill, Tom and Harry," to "Bill, Tom, and Harry", asks if we have not blundered in saying that such a sentence as "The Greek, Roman and English, have fought for liberty" is nonsense. Would "Bill, Tom and Harry, walked to town" be nonsense? he asks. In our opinion it would actually *be* nonsense, though it would be understood sensibly enough. Once it has been shown that the omission of the comma is essential for a particular meaning, its omission must be understood to imply that meaning, which in either of the sentences just given is absurd.

* * *

I have noticed many cases in well known writers, since I last wrote on the subject, where this point of punctuation has come in. As an example take the remark made by that very foolish person Silas Lapham, that that inconceivably snobbish hero Mr. Thomas Corey, has "an honest, fair and square face." The necessity for omitting the comma here implies the necessity for introducing it in such a sentence as "Tom Corey has a supercilious, conceited, and bumptious manner."

* * *

Mr. Howell's idea by the way of a refinement is amusing. The descendant of the Coreys (a sort of Norfolk Howard or "big bug" family it would seem) shows his refinement by discussing with his even more snobbish father, and with his unutterably coarse mother and sisters whether the lady he is supposed to love, is worthy of his aristocratically refined affections!

New Books to be Read—and Why.

King Solomon's Mines. By H. RIDER HAGGARD. (London: Cassell & Co.)—Because the story is full of interest and, though relating chiefly to an imaginary race of Africans, gives a good idea of life in Africa. Probably young readers may be led to suppose that there really is such a race as the Kukuanas, so natural is Mr. Haggard's narrative in all that relates to travel, customs, and the like. The fighting is a trifle complicated, however, and in particular the combat between Twala and Sir Henry Curtis is rather too much in the style of the great fight in the "Legend of the Rhine" (if only Twala had made a few remarks after his head was removed, the resemblance would have been perfect). The behaviour of the sun and moon in Kukuana land is remarkable. The sun has scarcely set when the fine crescent of the moon rises in the east. This, to say the least, is unusual. But a crescent moon which could thus face the sun would do anything; so that we are not greatly surprised to find the moon full next night; and eclipsing the sun the day after. The eclipse of the sun, also, is remarkable; for total darkness lasts for nearly an hour. We do not have such solar eclipses, or such a strangely acting moon, outside of the neighbourhood of King Solomon's Mines. No wonder they have not been found except in fiction. Possibly they never will be.

Tiryns. By Dr. HENRY SCHLIEMANN. (London: John Murray. 1886.)—Because, in this account of his excavations and discoveries in the prehistoric Palace of the Kings of Tiryns, Dr. Schliemann extends and developes that knowledge of a period lost in the mists of the hoariest antiquity, for which we are indebted to his former researches in Mykenæ and Troy; and shows us something of the vast architectural resources and considerable artistic taste of a people whose very existence has been conceived to reside only in myth and legend.

Methods of Research in Microscopical Anatomy and Embryology. By C. O. WHITMAN, M.D. (Boston: S. E. Cassino & Co. London: Trübner & Co.)—Because it contains in a succinct, readable, and thoroughly intelligible form as comprehensive a series of instructions as we have seen for the histologist and embryologist. Mounting, staining, section-cutting, injection, the rearing of various forms of organic life, &c. for embryological research, &c., &c., amply illustrated and well indexed, are some of the subjects treated of in a volume invaluable to the physiological microscopist.

A First Course of Physical Laboratory Practice. By A. M. WORTHINGTON, M.A. (London: Rivington. 1886.)—Because it is a most intelligently-written and admirably-arranged book for all incipient students of physical science, and may be thoroughly recommended as a trustworthy introduction to more pretentious works on the same subject; such, for example, as Glazebrook and Shaw's "Practical Physics" in Longman's series.

Our Land Laws as they are. By H. GREENWOOD, M.A. (London: Sampson Low, Marston, Searle, & Rivington. 1885.) Because it contains the best popular account that we have so far seen of the existing laws which regulate the possession and tenure of land in England—a subject on which an enormous amount of nonsense has been but too recently uttered. Mr. Greenwood strives earnestly to be impartial, but professional prejudices perforce peep out here and there, No layman certainly can

read the account of copyhold tenure without regarding it as as great an anachronism as the ordeal by fire, and as a simple scandal to our vaunted advancement in this nineteenth century.

History of Homœopathy. By W. AMEKE, M.D. Translated by A. E. DRYSDALE, M.B. Edited by R. E. DUDGEON, M.D. (London: E. Gould & Son. 1885.)—On the principle *Audi alteram partem.* Having, doubtless, heard Hahnemann and his followers denounced as Charlatans, the reader may here learn (on the authority of the Trinity of Homœopaths whose names appear on the title-page), how every one who opposes or ever has opposed their fetish, can only have been actuated by sinister motives. Notably does Dr. Dudgeon seem to suffer under the hallucination that no man can possibly reject homœopathy from pure and disinterested motives.

The Diseases of Sedentary and Advanced Life. By T. MILNER FOTHERGILL, M.D. (London: Baillière, Tindall, & Co. 1885.)—Because it contains a whole mass of information of the highest value and importance to the very large class which it addresses. Not only is it written in a style to render it most helpful and instructive to the lay reader, but it contains much which will be found useful by the medical practitioner. It is an eminently practical book.

There also lie before us, each addressing its own public, CLARK's most useful *Transit Tables for* 1886. (London: E. & F. N. Spon.) *A Digest of English History* 1760–1815. By M. GUTTERIDGE, B.A. (London: Relfe Brothers. 1885.) *A Handbook of French Composition.* (London: E. Stanford. 1885.) *Wilfred and Marion*, a drama in five acts. By EVAN ALEANDER. (London: Tinsley Brothers;) and a *Chart of Ancient Greek History.* (Edinburgh and London: W. & A. K. Johnston.)

Diaries.—Among the Diaries published for 1886 we must specially commend the Court Diaries in four different sizes issued by Griffith, Farran, & Co. (very full and convenient); Blackwood's excellent shilling Scribbling, Foolscap Octavo, Tablet, and Penny Pocket Diaries; and Pettitt's Scribbling and Octavo Diaries, both of which are capital.

SEASONABLE NOVELTIES.—The present season is generally regarded, for some occult reason, as an occasion for the giving and receiving of presents, perhaps in order to accentuate that "peace and goodwill" which is a special feature of Christmastide. But, however that may be, those desirous of giving presents to young people could scarcely make a better selection than the "Guinea Christmas-box" issued by the London Stereoscopic and Photographic Company, of Cheapside and Regent-street. It is equally amusing and instructive, and contains as many as sixteen varieties of scientific toys, puzzles, interesting games, and bewildering conjuring tricks. Another novelty, for which the protection of the patent office has been obtained, is one that will undoubtedly secure recognition in the daily-increasing ranks of amateur photographers. This is the "Amateur Travelling Bag," which is fitted with every requisite necessary for the production of photographs, while it preserves the external appearance of an ordinary travelling companion; thus securing the immunity from observation which is so dear to many people. The Stereoscopic Company have also published a handsome portfolio comprising a tastefully-mounted selection of the photographs which were prize-winners at the exhibition of amateurs' work held a few months ago in Bond-street—an exhibition which owed its success chiefly to the enterprise of the company. The pictures in the portfolio under notice are arranged in accordance with the classes in which they were originally exhibited, and are accompanied by the artists' names, and other detailed information. A visit to the company's premises will be amply repaid by the opportunity afforded of inspecting their choice collection of photographs, comprising portraits, groups, and landscape-work.

Our Whist Column.

LEAD FROM ACE FIVE.

BY MOGUL.

ABOUT twenty years ago, I ventilated in the *Field* my objections to the lead of Ace from Ace and four small ones. The discussion that ensued was inconclusive, because certain probabilities affecting the question had not then been calculated, and my arguments fell on barren soil. They nevertheless appeared to me so weighty, that it has been my practice ever since to lead a small one from Ace and four others, except when one of the four is the Queen or Knave, in which case I lead the Ace. My objections to the lead of the Ace were (1), that it deprived my partner of all chance of making the Queen, if held either singly or with one other: if alone, it fell to my Ace: if singly guarded, it fell to the adversary's King whichever side the King was held, and in cases where the Queen was doubly guarded, it either fell on the second round to the fourth player's King, or, if it survived to the third round, not only would it block my suit, but would almost certainly be trumped, as one of the adversaries must run short in the third round. (2.) It diminished the chance of at once establishing the suit by getting three rounds out, as it was two to one against a partner holding the King on the second round, whereas it was nearly an even chance that he would win the first trick; and (3) if partner proved weak it gave up the lead and the entire command of the suit merely to secure one trick in it, and deprived the Ace of one of its greatest uses—viz., the capturing a good card of an adversary; and these objections were encountered solely because one of the adversaries might hold one only of the suit, and consequently might trump the Ace on the second round. This always appeared to me an insufficient reason; but when the Queen or Knave was one of the four others, my objections were so much less forcible that in that case I have continued to lead the Ace. The result, so far as I can judge, has been so very satisfactory that, unless it can be shown on an exhaustive calculation of the chances of gain or loss, that the probability of loss by leading a small one is really serious, I should, on the strength of my experience, advise players to lead a small one from Ace five, unless one of the five be Queen or Knave. That this can be shown is very unlikely, for since I wrote Pole has calculated the chances of the leader (holding Ace Five) making one trick in the two first rounds of the suit accordingly as he begins with the Ace or a small one, and the result he arrives at is that one trick will be made eight times when Ace led for every seven times it will be made when a small one led. Now, although I cannot quite follow Pole's figures, and think that the difference is not so large as he makes it, for he assumes that the Ace will always be trumped in the second round when either adversary fails, whereas this would not be the case when the suit is returned by partner and the adversary failing is then second player; I still consider that, taking his result as correct, the advantages accruing from the lead of a small one, especially the increased chance it affords of getting three rounds out and at once establishing the suit, more than outweigh, in each case, the loss of one-eighth of a trick, *i.e.*, the lead of a small one will in eight times be the means of gaining, as compared with the lead of the Ace, more than one trick.

The lead was considered in your Whist Column of June 12, 1885, but the writer there makes the same mistake as Dr. Pole in assuming that the original fourth player, when he fails in the second round, will, as a matter of course, trump the suit when led on his right. Re-arranging the figures there given, I find that the Ace will make on second round twenty-two times for every twenty-seven and a half times it would make if led out in first round. This would be the loss of about the fifth of a trick every time a small one is led; but this seems to me fully compensated for by the increased chance it gives of the Queen, if held single or with another, making in the first round, and I find on calculation that the chances of making the two first tricks in the suit are equal, whether Ace or small one be led, but when it is considered that more tricks would be made in the two rounds when a small one is led, were it not that the adversaries will now and then trump the ace on the second round. Have we not a right to assume that this expenditure of a trump will, in a certain proportion of cases, say half or one-third, lose our adversaries a trick in other ways? Now and then it may prevent an adversary getting in his long suit and enable your partner to get in his. The conclusion that, on the whole, the lead of a small one is advantageous, is, I consider, irresistible, and certainly it is more in harmony, than is the lead of the ace, with the principles which regulate a lead from a long suit headed with one high card.

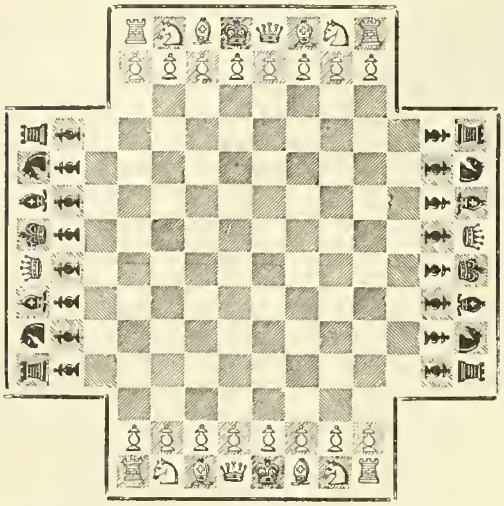
Our Chess Column.

BY MEPHISTO.

FOUR-HANDED CHESS.

YELLOW.

RED.



BLACK.

WHITE.

As may be seen, the board in the four-handed game consists of three additional rows on each side, making altogether 160 squares, and the game is played with four sets of men of different colour, by four players.

Two players always play in partnership together, that is to say, the two sitting opposite each other play against the two players on their right and left respectively, who are likewise partners. Thus White and Yellow are partners playing against the two partners Black and Red. The game is won when both partners are check-mated.

The pieces of two partners have virtually the same powers. They support each other, but cannot attack nor take each other; thus, for example, the Yellow Q could not give check to White's K; nevertheless each player may only move his own pieces.

The principal feature of the game is that both partners co-operate both for offensive as well as defensive purposes against the two allied adversaries. To give a better idea of the complex nature of the game, we must assume that the middle of a game has been reached; it being White to move, White must, in the first instance, see whether Black threatens him, whether Red can after he has moved make a move against White, which Black can subsequently support when it again comes to his turn. White must also see whether his partner, Yellow, is threatened in a similar way, and he must attempt to penetrate the designs of Black and Red. The four Queens are always on four white squares.

The Pawns can only move one square at a time. Castling is not allowed. If the Pawns of two allies meet on the board, they may jump over each other, the same as in draughts. Apart from these deviations, the moves of the pieces are the same as in Chess.

If a player is mated, his pieces become inanimate, they can neither move nor be captured. The game proceeds as long as the partner of the mated player, singly, can fight his two opponents.

If a player is mated, it by no means follows that he must remain so for the rest of the game. Immediately the mating check gets removed he resumes play as before. A partner can, therefore, release his partner from a mate by attacking the mating piece and compelling it to move, or capturing it. In fact there may arise positions where it is a positive disadvantage to mate an adversary. For instance: White has lost his Queen. His partner, Yellow, can mate Black with his own Queen, which, however, might expose him to the strong attack of Red, White not being able to assist him much. The principal of mutual support is applied in many ways in this game. For instance, supposing it is Yellow to move in a certain position, the red K stands on K sq., Yellow may, with his unsupported Queen, check red K on K2, and in case Black can do nothing to prevent White from supporting his partner's Queen, say, for instance, by placing his B on Q3, then Red would be mated; the same as if the B on White's Q3 would be a Yellow B.

Another favourite trick of players is the following:—It is White's move; of course he can operate against Red or Black as he may think best. If he can attack Black's Queen with a Pawn or minor piece, and provided always Red cannot help his partner, Black, then Yellow, if he can do so, will check the Black King. Black, when it is his turn to move, must, of course, move out of check, which then will enable White to capture Black's Queen, which he attacked on the previous move.

Each player moves alternately from right to left; *i.e.*, White, Red, Yellow, Black, White, &c.

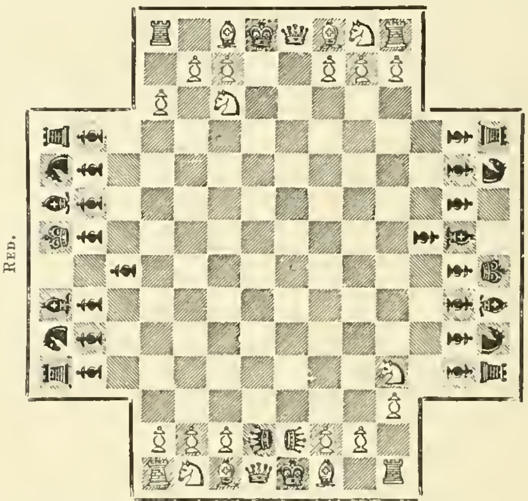
By drawing a temporary board on paper and with two sets of chessmen, our readers may follow the following short game, given in "Chess Excentricities," by Captain Verney:

Round.	Yellow.	Black.	White.	Red.
1	P to K3	P to Q3	P to K3	P to Q3
2	P to KR3	Q to Q2	P to KR3	Q to Q2
3	KKt to KB3	Q × Yellow QP (ch)	KKt to KB3	Q × Yellow KP mate
4		QB to Q2	KKt to KR4	Q × White QP (ch)
5		Q × White KP mate		

The following diagram represents the end position of this game:

YELLOW.

RED.



BLACK.

WHITE.

In the above diagram it will be seen that Yellow is mated by being checked both with the Black B on Black's Q2 and by the Red Q from White's Q2. White is mated by the two Queens.

A comparison can hardly be drawn between this game and ordinary Chess. There are, however, features in this game which make it worth being cultivated; foremost amongst which must be mentioned that it engages four players instead of two, and even these may be increased to eight, by two players consulting on each side. We can quite imagine that a four-handed game—played by eight players, each side being taken by a lady and gentleman consulting together—would exercise far greater attractions in a social party than ordinary chess.

CONTENTS OF No. 2.

SPECIAL NOTICE.

"KNOWLEDGE" as a Monthly Magazine cannot be registered as a Newspaper for transmission abroad. The Terms of Subscription per annum are therefore altered as follows to the Countries named:—

	s.	d.
To West Indies and South America	9	0
To the East Indies, China, &c.	10	6
To South Africa	12	0
To Australia, New Zealand, &c.	14	0

To any address in the United Kingdom, the Continent, Canada, United States, and Egypt, the Subscription is 7s. 6d., as heretofore.

OFFICE: 75, GREAT QUEEN STREET, LONDON, W.C.

KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART

LONDON: FEBRUARY 1, 1886.

THE UNKNOWABLE;
OR,
THE RELIGION OF SCIENCE.

By Richard A. Proctor.

EARLY RELIGIOUS IDEAS: THE HUNTER—THE HERDSMAN.

IT would be easy to write a volume about the religious ideas of savage races. Tylor, Lubbock, and many other writers have collected multitudinous evidence to illustrate savage beliefs. Here I propose rather to present the results to which such accumulated evidence clearly points, and to show how such results correspond with the views to which *à priori* reasoning as clearly tends, than to fill page after page as I easily might. with quoted evidence. But I may remark that some of the matter recorded in these pages under the head of "Indian Myths" may be regarded as affording a very suitable, and sufficient illustration, though presenting the beliefs of only one race among one class of savage tribes.

We must regard the lowest class of savages as those who live either by hunting and fishing, or on the wild fruits of the earth, having neither flocks and herds to supply them with food, nor cultivated land to give them crops of various sorts in the proper seasons. Thus the earliest recognition of existences and forces outside himself came to men trusting to the wild products of the earth or entering into the struggle for existence with creatures scarcely wilder than themselves. It might seem that all traces of religious ideas having their origin in that remote time (for each now civilised race) when the progenitors of the race were thus slightly advanced beyond wild animals of the woods, could have left no traces on the religions of civilised races in our day. But no ideas and no customs are so long-lasting, as those associated with man's fates and fortunes as affected by external influences,—and in such ideas and such customs all religions had their origin. So that, as we shall presently find, not only the superstitions, but even the religions of to-day, bear traces of such notions as naturally sprang up among races living by agriculture, among earlier races trusting chiefly to pasture, and so backwards into time among races trusting wholly to the wild products, animal and vegetable, of land and river and sea.

That in the vegetable world those wild savage ancestors of ours should have found evidence of power and will, such as each individual man had learned to recognise in himself was natural. The tree which brings forth fruit, the herb, yielding seed, held later to be created things, were self-existent individualities to the earlier savage,—as they now are to many children, perhaps would be to all if left untaught. The rain which nourished vegetation, and the cloud from which the rain fell, were probably not so early regarded as powers, though they certainly came to be so regarded later. Vegetation must also early have been regarded from the point of view of the hunter. When the animals he pursued were sought in their lairs in grass or bush or tree, when in the pursuit of such animals vegetation in various forms seemed to afford either protection to wild creatures or assistance to the huntsman, then the idea of innate force in trees and shrubs would naturally arise. So also to the fisherman would the river seem a power,—as indeed it would appear, though in another way, to the hunter. Snow and wind, thunder and lightning, land and sea and sky, would ere long take their place among the existences and the powers which man in this earliest stage of savage life would recognise as influencing his fortunes.

But still more especially would various animals come to be recognised as having powers akin to man's own—nay in some cases greatly exceeding his. There would be the animals who took part with him in preying upon others,—the lion, the tiger, the bear, the crocodile,—mightier hunters than man, often making man himself their prey, and only to be overcome by men when many joined in the assault. There would also be those whose craft seemed so great that man had but small chance of capturing them for prey. There would be those—like the elephant, the hippopotamus, the rhinoceros, and the bison—whose ponderous strength secured them from attack. And lastly there would be others which, though weak and simple, were endowed with such agility, such keen senses, or such other protective properties, as often to elude the pursuit of even the keenest and most active huntsmen.

We can understand that in the struggle for existence, the peculiarities of such races of animals as had chiefly to be considered. whether because of their destructive or their self-preserving powers, would be keenly noticed. The fortunes of the huntsman, varying in a hundred ways with varying circumstances, would be associated with the various animals affecting them, in such sort as to suggest the idea of powers to be feared and to be propitiated. Often mere chance events would suggest the idea that some animals were lucky and some unlucky, or rather that some were of evil others of good influence. And by the way, we may be well assured that very early the serpent would be recognised by the hunter, even though he did not pursue it for food, and were not molested by it, as more subtle than any beast of the field.

Along with the growth of such ideas as these would proceed the development of the idea of a second self in each human being,—a conscious entity independent of the body,—an entity whose beginning was a mystery and whose end seemed no more likely to have come with the death of the body than it had come with sleep or trance. We can understand, then, how there would arise quite early the idea of a second self other than the visible form, in tree, shrub, and animal. We can see also how the idea would almost simultaneously arise that the second self in animals and trees, in earth and sea, in sky and in river, in rain, wind, lightning, and thunder—might not only be akin to the human second self, but might absolutely be human. The thought that when man dies his other self remains, would not long remain separate from the thought that power will and intelligence, akin to those of the human soul, may exist outside man. From the association of these thoughts would arise the belief that the souls of the dead animated the various natural objects on which the fortunes of the

savage hunter and his family—nay on which his life and theirs—seemed to depend. Belief in the transmigration of souls from animal to animal and from animal to man —would seem naturally to belong to this early stage of thought. But, as a matter of fact, men seem to have been more prone to consider the probable *future* of the second self of men who had lived, and especially of those who had seemed exceptionally fortunate, than to inquire into the past of that other self,—even as, in our own time, and among the most religious peoples, belief in the immortality of the soul continues one-sided, directed wholly to the future and having no reference whatever to the past.

So long as man continued to trust solely or chiefly in the natural fruits of the earth or in such food as he could obtain by hunting and fishing, his ideas of the existence outside himself of something akin to what he found in himself "welling up as consciousness" would be limited to the natural objects of various orders, the natural forces and processes of various sorts, which influenced his fortunes. With regard to clothing, as probably the earlier races of men lived where clothing was little needed—at any rate for their hardy frames, still in large degree clothed with hair where now only down attests the former hairiness of the human body—we may believe that any such artificial clothing as he began to require he would obtain from the skins of animals and the leaves of trees. The struggle for existence would not depend in such degree on the securing of such artificial clothing as to affect his ideas about existences outside his own. Man would in those early times be naked without much suffering, and certainly without being particularly ashamed.*

As the pastoral life gradually encroached on the life of the fruit eater, the huntsman, and the fisher, new recognitions of external influences would be introduced. The calf and the lamb would be more important to pastoral races, than the deer or the antelope. The regenerant powers of nature would have deeper interest than they had had of yore. Yet the influences of air and rain and sky would still be recognised,—nay they would be now recognised more clearly than when the comparatively rough and brutish huntsman faced with little concern the fury of the storm and the conflicting powers of the elements. Moreover the fiercer animals would still represent forces to be feared or to be propitiated. The bear and the lion, the wolf and the crocodile, especially if by this time they had been regarded as tenanted by human souls, would be regarded as requiring perhaps more than mere observance and respect—sacrifice would be offered to them. Nay sacrifice offered to some of the fiercer animals of prey would not be offered wholly in vain, vain though the belief might be that those animals were tenanted by human souls. For flocks and herds might be saved by well-devised sacrifices of calves or lambs. It is even conceivable that what was thus done originally with design belonging only to pastoral wisdom, might have been the beginning of sacrifices offered later with religious intent. Assuredly a custom so begun would develope in the fulness of time into a religious observance. So that we may put as among the quite possible causes of this special class of sacrifices—and therefore possibly of all sacrificial observances—a practice which men living by flocks and herds, such races "as dwell in tents and have cattle"—had found effective to save many by the sacrifice of a few.

Probably the observance of the heavenly bodies would have begun with the pastoral stage of the particular race or races of men from whom the religions in which we are chiefly interested had their origin. I believe that the full faith in the influences of the sun moon planets and stars, the clear recognition that they are for signs for seasons and for days and years, belonged to a later stage of development. But we can hardly imagine that pastoral races would long have failed to observe the stars in their courses, or observing them have long escaped the thought that on their motions depend the fortunes of their herds and flocks. In the first place the life of the herdsman, unlike that of his predecessor the huntsman, was one specially requiring nightly watch. It is not a mere vague fancy or an idle tradition that races which of old "watched from the centres of their sleeping flocks" were the first astronomers, or that they early recognised in the planets, orbs like radiant messengers, that seemed to move as though "carrying through æther in perpetual round," the influences and almost "the decrees and resolutions" of external powers.

Thus as the calf (witness the golden calf for worshipping which the Jewish people were punished) and the lamb became early religious emblems, so we find among the most ancient objects pictured by men's fancies in the heavens, those animals in which the shepherd was especially interested. There we find the Ram and the Bull, the Waggoner bears on his shoulders the two Kids, the Herdsman with uplifted arms (well seen in the heavens even now, though no longer existing in star maps) drives away from his flocks the Bear and the Lion, the creatures which as we know were most dreaded by the shepherds of oriental countries.

We cannot doubt that at this stage of man's development the movements of the sun and moon would be noted, though as yet perhaps the sun would be but slightly considered. The moon would acquire at this early stage the character which was afterwards more distinctly recognised in her,—that of the measurer of time, a character indicated in the name which all eastern races gave to her. She was described indeed by two names, one indicating measurement the other light, and among the Greeks the former was scarcely ever used, while among the Romans it was altogether lost except in compounds relating to the month: but in older languages the measure name of the moon was the chief, in some cases the only one, and it still remains among ourselves. To pastoral races the moon's value as a time measurer would obviously be great. To this day

* It may indeed be said,—I offer the idea as suggesting a new symbolical interpretation of the history of Adam and his family—that Adam may be regarded as before the fall typifying savage man living simply on the fruits of Nature's garden: while after the fall he typified man living alike on the fruits of the earth and on his fellow animals. Abel the next man may in like manner be regarded as typifying pastoral races,—and Cain the third as typifying races which later lived by agriculture, from whom descended fresh pastoral races of the nomadic sort, and later civilised races, artificers and artisans as well as races possessing artistic skill. We should escape thus—if we conceive escape to be necessary from the unscientific and in reality inadmissible idea that all pastoral races descended from Jabal, all agricultural races from Cain, all artificers from Tubal-Cain, and "all such as handle the harp and pipe" from Jubal. Such accounts, interpreted literally, are fit only for children or for child races. Interpreted symbolically and allegorically, they need not be regarded as necessarily more inadmissible than the seeming accounts of nations being descended from a single pair (even the whole human race as so descended), accounts which as interpreted literally could only have had their origin among men ignorant alike of biological and physiological laws. Men who view the bible account as expressing simply what the wisest men of those unlearned times thought about such matters, need not be at the pains to sift out the symbolical from the literal. For them the record as it stands is full of interest in many ways; but in its freedom from all effort to introduce later knowledge into a very ancient attempt to solve the mysteries of existence—it is especially interesting to the student of the past of religion.

the times of calving and lambing are measured among countrymen by moon circuits. In pastoral life, again, began the practice of hiring labour; and we know that from the very beginning labour was hired by the month and by the week, that is by direct reference to the moon, a practice which has reached to our own time, and probably will last so long as the human race endures upon the earth.

But it was not until agriculture began to replace pasture, as pasture had replaced hunting, that the heavenly bodies of various orders, and the sky which held them, became the objects of special attention,—merging gradually into veneration and into adoration. The beginning of the actual ceremonials and theologies of our day must be referred to this stage of human progress. It may well be that much even of the theological doctrine of our time. and it is certain that much of its ceremonial observance, must be referred to the time when first men began to till the earth for their subsistence. The evidence on this important part of my subject comes next then to be considered.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By EDWARD CLODD.

IV.—THE PAST LIFE-HISTORY OF THE EARTH.

GEOLOGY deals with the stuff of which the earth is made, with its origin, structure, and arrangement. But so inter-related is the material of which all things are spun that inquiry into the structure of rocks has to be extended well-nigh at the outset to their contents—that is, to the fossil forms or imprints of ancient life which are not only preserved within the larger number of strata, but which entirely compose vast masses, as in the coal-measures, chalk hills, and coral islands. Therefore the interest which the study of the earth's crust, of its erupted, fire-fused, and water-laid rocks, awakens, especially in their witness to ceaseless changes through an ever-receding past, becomes more immediate and human when the relics of ancient life-forms are examined, and their appearance, persistence, or disappearance; their order and succession in an ever-varying, ever-ascending scale, traced. For in them lies the record of *life* on the earth through measureless time, the life that was, parent of all life that is; from simple slime-speck to structure of subtlest complexity named man, with its passionate story of agonies and joys, of struggle towards a kingdom of heaven yet unentered.

True it is that the record is very imperfect, that the gaps remain wide and numerous even when supplemented by remains from other parts of the globe. But the wonder is that the blanks are not greater, when the nature and extent of the changes to which all rocks have been, and are being, subjected are considered. In addition to the havoc and effacement wrought by the earth's internal heat, and by divers agencies to be dealt with in due course, the formation of every deposit involves the waste of an older deposit, which has in its turn been derived from more primitive stuff, the effect throughout being injury to, or destruction of, the organic contents. It is impossible that the vast number of lowest life-forms, whether plant or animal, should have been preserved. Traces of marine organisms survive in the trails and borings of sea-worms, or in the imprint of carcasses of jelly-fish stranded on the ripple-marked mud of ancient sea-shores, but of the soft-bodied creatures themselves not a vestige remains. Only the hard parts of animals and plants; shell, skeleton; wood, bark, seeds; would reach the fossil state in more or less perfect form, and even their preservation is contingent upon the nature of the beds in which they are interred. As it is, but a remnant of all that ever lived in the water, and a far less proportion of the smaller population of the land, are represented in actual fragments. Sometimes only an impression survives, as when a dissolved shell has left its witness in cast or mould in clay or mud, or an extinct bird or reptile its foot-prints on the sands of a far-off time. Sometimes, in the compensating action of nature, chemical agents, in destroying the original structure, infiltrate the vacancy with minerals, replacing the form, occasionally in minutest detail.

Rich as are igneous rocks in wealth-yielding mineral veins and ores, they are, save where recent plants and animals have been accidentally enveloped in the flowing lava or dust of volcanic eruptions, destitute of fossils. There was a period in the earth's history when life was not, and its beginnings, which were probably in north polar regions, were certainly subsequent to the ejection of the molten or pasty masses which cooled into true volcanic or fire-formed rocks.

Fossils are found only in sedimentary rocks, although not universally in these, many of them having no organic remains. Varied and mixed as they are in composition, their specific names and differences need not be detailed here, and it suffices to group them under two heads—namely, those derived from sediment in its several states of gravel, sand, and mud; and those formed of the remains of plants, as coal in its several stages from peat to the hard graphite or black-lead of the older formations; or of the remains of animals composing chalk, limestone, and other organically-derived rocks. But whatever their source, and however much the original order of strata has been deranged by hidden agencies which have tilted them at all angles, cleaved and contorted them, and superposed the older on the newer, there is a well-ascertained succession in them which their fossils alone have enabled us to determine, each formation having its own characteristic kind or dominant type of animal and plant. Not that there are any hard-and-fast lines between the disappearance of an earlier species and the appearance of another, the forms being often commingled. Some of the low and simple types persist through almost all formations, some of the more complex are found in only one or two formations, but there is a merging of one into another; there are gradations and alliances of type, as of birds with reptilian characters and *vice versâ*. And although seemingly isolated types occur, or the divergence between earlier and later types has blurred their relation, it will be seen that the modern are the ancient slowly and wondrously modified. In short, the life-history of the globe is one both of unbroken relation and progress.

Before summarising the formations and their typical fossils, the order and nature of past life-forms, more especially in their relation to present life-forms, will be made clearer by the accompanying schedule of the sub-kingdoms into which existing plants and animals are divided, beginning in each case with the lowest. For it will be seen that these divisions apply to fossil plants and animals, since they conform so completely in structural plan to the types represented in the several sub-

kingdoms, that there is no known fossil for which a new sub-kingdom is required :—

I.—PLANTS.

Sea and other Water-weeds (*Algæ*) Lichens Fungi	Gymnospores, *i.e.* naked spores.
Mosses Ferns and Horsetails Club Mosses	Angiospores, *i.e.* enclosed spores.
Pines and Palm Ferns	Gymnosperms, *i.e.* naked seeds. (many seed-lobes).
Grasses, Sedges, Palms (one seed-lobe) Trees, Shrubs, Herbs (two seed-lobes)	Angiosperms, *i.e.* enclosed seeds.

II.—ANIMALS.

1. Invertebrates, *i.e.* without backbone.

Monera* (gr. *monos*, single)	Structureless, sticky, alike all over.
Amœba* (gr. *amoibe*, change)	Slight unlikeness of parts; always changing shape.
Foraminifera (Lat. *foramen*, an opening)	Secrete shell or skeleton of lime from water. Show passage to further unlikeness in parts.
Polycystina (gr. *polus*, many, and *kustis*, a cyst)	Secrete shell or skeleton of flint from water.

Sponges.
Coral-animals, anemones,* jelly-fish.†

Sea-lilies, star-fish.

Worms of all kinds.
Crabs, spiders, centipedes, insects (Crustacea).

Sea-squirts. (Ascidia) Oysters, snails, cuttlefish	Mollusca.

2. Vertebrates :—

A. *Pisces.*
Lancelet (Amphioxus).
Fish of all kinds.
B. *Amphibia.*
Toad, frog.
C. *Reptilia.*
Serpent, lizard, crocodile, turtle.
D. *Aves.*
Birds of all kinds.
E. *Mammalia.*
1. Aplacental (bringing forth immature young). *Monotremes*, or one-vented; duckbill; spiny ant-eater. *Marsupials*, or pouched; kangaroo, opossum.
2. Placental (bringing forth mature young):—Ant-eater, manatee; whales and porpoises; horse and all other hoofed animals; elephant; seal, dog, lion, tiger and all other flesh-feeders; hare and all other gnawing animals; bats; moles and all other insect-feeders; apes; man.

The following sub-divisions of the stratified rocks indicate the order of their succession. There is no one section of the earth's crust where a complete series is to be found with layer superposed on layer like the skins of an onion; but whatever gaps exist locally do not affect the relative age and place of each stratum which, as noted above, are fixed by the fossils :—

Epoch.‡	Systems.
Archeolithic and Primary	Laurentian, Cambrian, Silurian, Devonian or Old Red Sandstone, Carboniferous, Permian.
Secondary or Mesozoic	Triassic, Jurassic or Oolitic, Cretaceous.
Tertiary or Cainozoic	Eocene, Miocene, Pliocene.
Quaternary or Post Tertiary	Recent (Pre-historic, Historic).

Before passing to a rapid summary of the leading fossil contents, it may be remarked that no uniform principle has governed the choice of their system-names. Sometimes they indicate the place where a system is markedly developed, sometimes the typical features of the system, but they are the accepted nomenclature in all treatises on geology, and are therefore adopted here.

The *Laurentian* rocks, vast and venerablest sediments of primeval seas, are highly metamorphic. Heat, moisture, and enormous pressure have changed their sandstones into sparkling crystalline rocks, their limestones into veined and variegated serpentines. Formerly they were classed as "Azoic"—*i.e.*, without life—but of late years those which form the Laurentide mountains in Canada, whence the general name of the series, have acquired special interest from the discovery of certain veined structures in them which, on balance of evidence, are pronounced to be the remains of a marine animal, very large of its kind, related to the group of the Foraminifera, which possess the power of secreting lime from the water, and forming therewith perforated shell-coverings of exquisite symmetry and beauty.

Certain members of these lowest life-forms might smile at man's "claims of long descent," for they have survived through the long and change-bringing millions of years to this day, shedding their shells on the deep ocean floor, as their ancestors shed theirs and built therewith the vast chalk and limestone hills and mountain ranges in relatively shallow seas. While some secrete chalk, others secrete flint, among which last are the minute plants known as Diatoms, whose remains compose, among other deposits, the "rottenstone" used as polishing powder, with little thought on our part that no less than forty-one thousand million skeletons go to make up a single cubic inch.

Even if the organic character of *Eozoön Canadense* were disproved, and we do not witness in it, as its name implies, the "dawn of life," abundant traces remain that the Laurentian waters teemed with living things. For the limestones, the abundant graphites, and the great beds of iron ore which occur in its rocks, are due to the action of animal and plant life.

The *Cambrian* rocks, which are less metamorphic, add little to our knowledge of primitive plant-forms, such as are preserved being probably Algæ, or sea-weed, corresponding to the tangles covering large areas of the Atlantic, especially the Sargasso Sea. But the system is fairly rich in fossils of marine animals, themselves the descendants of a long line of perished ancestors. Sponges, sea-lilies, and low forms of mollusca or true shell-fish are found; but the typical and most perfect fossil is that of the three-lobed crustaceans called trilobites, which swarmed in those ancient seas, and survived till the Carboniferous period.

The *Silurian* rocks, though exhibiting in crumpled and rugged mountain-chains the action of agents both above and below the earth, are much less metamorphosed than the preceding systems. They are in large measure the worn fragments of land areas which stretched across northern Europe for above two hundred miles into the Atlantic, the sediment being deposited in a shallow sea which then covered central and southern Europe, and the floor of which was slowly raised as a primitive European continent at the close of the Silurian period by subterranean movements. The most interesting land fossils are those of plants allied to huge club mosses, ancestors of the gigantic forest-kings of Devonian and Carboniferous times, while the marine remains are varied and numerous, comprising seaweeds, foraminifera, corals, starfish, shell-fish of every kind, trilobites, and with these huger lobster-like crustaceans, sometimes measuring above six feet in length.

* No fossils of these soft-bodied lowest forms exist.
† Impressions of bodies only.
‡ Vide Knowledge, January, p. 78.

But the most important fossils are those of the earliest-known and lowest class vertebrates in the form of armoured fishes, allied to our sturgeon, and called ganoids (Gr. *ganos*, splendour; and *eidos*, form), from the brilliancy of their enamelled scales.

In this seemingly sudden appearance of highly-organised animals marking so great an advance in structure on the higher invertebrates, the imperfection of the geological record is brought home to us. If later forms are modified descendants of earlier, then not only are the transitional ancestral forms of the ganoids missing, but the species itself is much older than the fossils imply. The inquirer need not despair; for only a limited portion of the dry land has as yet been explored, and there are vast fossil-holding areas submerged and inaccessible; yet one by one missing links are being found, and if the ancient intermediate forms, with their shorter life-span, between the higher mollusca and the lowest vertebrates, elude us, fortunately there are extant organisms through which the connection can be traced.

In this brief survey of the three earliest systems we have already traversed more than half the total thickness of the fossiliferous rocks, the deposit of which involved a lapse of time and series of changes of which no conception is possible. The base-line of our life is too short for measurement of the distance which separates the foraminifera from the ganoids; of time, as of space, we see neither beginning nor end.

HISTORICAL PUZZLE.

By Richard A. Proctor.

ONE of the most remarkable problems—one might almost perhaps say puzzles—of history, is the entire absence of any reference by Josephus to those events which according to the gospels took place in Jerusalem during the years which preceded his birth. He was regarded by his contemporaries as a sagacious, careful, and well-informed man, especially in regard to the history of his own country, and still more especially of Jerusalem during the century preceding the capture of that city. His father resided in Jerusalem throughout the whole time covered by the life of Christ according to the narrative of Matthew (that is from B.C. 4, determined from the death of Herod the Great, to A.D. 33) or according to Luke (that is, from A.D. 9—the taxation by Cyrenius—to A.D. 33) or according to the narrative of John (which, if the remark "thou art not yet fifty" be taken in its natural sense would be different from either). It is evident, independently of the evidence of Josephus, that his father, and the whole family, were in a position of dignity, while also in such a position that they could not but hear of everything of interest which happened in Jerusalem, or indeed anywhere in Palestine. It is absolutely impossible that they could have remained ignorant of the strange events which took place in their own time and country, events which we are told moved even the most conservative minds to recognise that a man of marvellous powers as well as of profound insight and of singularly pure and blameless life, was in the land. At the time when the whole city of Jerusalem was stirred either to sympathy with Christ and his followers, or to anger against them, when the powers of nature were moved, insomuch that the sky was darkened, while the graves opened and gave up their dead, who going about were seen of many, the family of Josephus must have been among those who marvelled at these strange events and were terrified by such tokens of divine displeasure. That a man so careful to collect even the most minute details about these very times, having access to all the public records (even to the sacred records of the priesthood), to the evidence of all the leading men and families, and who lastly must repeatedly have heard the members of his own family speaking about these marvellous yet well-known events, should have either overlooked them or thought them not important enough for mention, must be regarded as utterly incredible.

Yet Josephus, as is well known, says nothing whatever, either about John the Baptist, or about Christ, or about the Apostles or disciples of Christ. So remarkable did this silence seem to the early Christian writers, that after Photius had dwelt upon it in his articles on Josephus, a passage was interpolated relating to John the Baptist; and after Origen (taking the interpolated passage as genuine) had dwelt on the still more striking circumstance that Josephus referred to John the Baptist but did not refer to Christ, another passage was interpolated in which Josephus appears to refer to Christ in terms implying that he regarded Christ as the promised Messiah. Although in those uncritical days this forgery passed muster, as did many much more glaring, yet now no critic of repute admits this incongruous paragraph (clumsily inserted where—if Josephus could have written it—he assuredly would not have placed it) as genuine. As Bishop Warburton said, it was clearly "a rank forgery and a very stupid one too," and "it has long been given up," says De Quincey, "as a forgery—by all men not lunatic." Those who introduced it had pious intentions, no doubt; but they were apparently not conscious of the bad effect its appearance would have, after the regrets expressed by Photius and Origen in regard to the absence of any reference to Christ in Josephus's works. It was much the same in this case, as with the addition to the Annals of Tacitus of a passage relating to persecutions of Christians by Nero (at a time when according to the Acts of the Apostles the Christians were left in peace) though the early Christian fathers who had ransacked Tacitus, Suetonius, and every Roman writer, for just such passages, had failed to find anything of the kind in those works as known in their day. Such forgeries, as Bishop Warburton implied, were most mischievous as well as most unwise, however they may have commended themselves to men of the type of the Christian historian Eusebius, who expressly taught that "falsehood may be employed by way of medicine for those who need it," and boasted openly that he had "related all which might redound to the glory and suppressed all that could tend to the discredit of our religion."

Canon Farrar, in his "Life of Christ," takes at once a bolder and a wiser course in regard to this historic puzzle. "No one can doubt," he says, "that the silence of Josephus on the subject of Christianity was as deliberate as it was dishonest." "The probable reason of this silence," he remarks further, "is that Josephus, whom, in spite of all the immense literary debt we owe to him, we can only regard as a renegade and a sycophant, did not choose to make any allusion to facts which were even remotely connected with the life of Christ."

This of course explains the whole matter, as completely and unanswerably as what is sometimes ungallantly called "a lady's reason." If Josephus was silent on the subject of Christ because he did not choose to speak, it might seem that there is nothing more to be said.

But the dishonesty of this renegade from Christianity, (this sycophantic "Hellenising courtier" who was in favour both with Vespasian and with Titus, and was even suspected of being able to obtain favours for his countrymen from both emperors, father and son) so soon as it is admitted in interpretation of this remarkable historical puzzle, may perhaps explain other singular features of Josephus's writings. He seems to have been not only dishonest, a renegade, and a sycophant, but a singularly bold yet crafty plagiarist. Unless we admit the occurrence of a series of accidental coincidences, highly improbable as such, we shall find that Josephus adorned his narrative (which he pretended to advance as "neither hiding nor adding to the known facts," and which he challenged all men living in his day to contradict if untrue in any particular) with events, characters, and descriptive passages manifestly stolen from the gospels, or from some earlier Christian gospel, known to him, but which has not descended to our time.

It need hardly be noted, except as belonging to the evidence of Josephus's guilt, that he ascribes to a religious sect among the Jews, already numbering, he says, 4,000 persons, the doctrines which were actually taught by Christ and his apostles—for this of course is well-known. De Quincey, indeed, strove to show that the members of that sect were in reality early Christians. But it is far easier to suppose that Josephus found in Christian doctrines materials for an interesting paragraph, while, by avoiding all mention of the author of those doctrines, he helped to carry out the deliberate and dishonest purpose attributed to him by Canon Farrar.

Josephus referred to a Galilean (and Christ we know was regarded as a Galilean) who taught new doctrines, insomuch that his followers "did not value dying any kind of death, nor indeed did they heed the deaths of their relations and friends, nor could any such fear make them call any man lord."—"Nor am I afraid," he proceeds, "that anything I have said of them should be disbelieved, but rather fear that what I have said is beneath the resolution they show when they undergo pain." He calls the founder of this sect Judas; but naturally his dishonesty would lead him to alter the name.

Josephus describes how a certain man promised great things to the Samaritans, insomuch that they followed him to Mount Gerizzim in great multitudes,—but Pontius Pilate, he says, prevented their going up, and ordered the death of their leader. For this, he says, Pilate was presently blamed, and had to go to Rome to defend himself before Tiberius—but Tiberius was dead when he reached that city. He doubtless put this story into his narrative to give another aspect to what he must have known was the real murder for which Pilate, in the last year of the reign of Tiberius, fell into trouble.

Josephus describes one named Jesus, who long after the events recorded in the Gospels, displayed some of the most marked characteristics ascribed by the evangelists to Christ. This man proclaimed woe to Jerusalem, sorrowfully yet steadfastly, for several years. This Jesus, "a plebeian," says the historian, "four years before the war began, and at a time when the city was in great peace and prosperity, came to that feast whereon it is our custom for every one to make tabernacles to God in the Temple, and began on a sudden to cry aloud, 'A voice from the east, a voice from the west, a voice from the four winds, a voice against Jerusalem and the holy house, a voice against the bridegrooms and the brides, and a voice against this whole people.'" When the most eminent conceived great indignation against him, and gave him many stripes, "yet did not he either say anything for himself, or anything special to them that chastised him, but still went on with the same words as before." Hereon the rulers of the Jews brought him before the Roman procurator, as "a man possessed with a divine fury"; whereon "he was whipped till the bones were laid bare; yet did he not make any supplication for himself, nor shed any tears," but cried only "Wo, wo, to Jerusalem." Thereafter till the end came (when with a loud cry, "Wo, wo to myself also," he met his death), "he did not give ill words to any of those that beat him every day"—but his reply to all men was the same lamentable cry, "a melancholy presage," says Josephus, "of what was to come."

That Josephus dishonestly transferred—with such change as to partly hide his offence—events which really occurred earlier, to the time of the siege of Jerusalem, becomes clearer yet when we note further, that he tells us how, at the same sad time for Jerusalem—1, a heifer miraculously brought forth a lamb, "as she was being led by the high priest to be sacrificed"; 2, at the same time (the Feast of the Passover) a light shone round the altar and the holy house, so great that it appeared to be bright day-time; and 3, a star resembling a sword stood over the city. All these prodigies were manifestly suggested to him by the Gospel narrative. He also says that shortly before this time (about thirty-four years after the close of Christ's ministry) Zachariah the son of Baruch was murdered by the people in the very temple itself—as if with the manifest intention of casting doubt on Matthew's account of Christ speaking to the Jews of "Zachariah son of Barachiah," as one "whom ye slew between the temple and the altar." The evidence of deliberate purpose here is too obvious to be overlooked. It is singular, too, that in the account of the prodigies before mentioned, Josephus includes an event manifestly borrowed from what is recorded of Peter in Acts, chap. xii., when the iron gate opened of its own accord: for he tells us that the eastern gate of the temple, "which had with difficulty been shut by twenty men, and rested upon a basis armed with iron, and had bolts fastened very deep into the firm floor, which was then made of an entire stone, was seen to be opened of its own accord about the sixth hour of the night." "Now those," he proceeds, "that kept watch in the temple came hereupon running to the captain of the temple and told him of it; who then came up thither and not without great difficulty was able to shut the gate again." From Acts also, Josephus has manifestly borrowed the following: "Moreover, at that feast which we call Pentecost, as the priests were going by night into the inner temple, as their custom was, to perform their sacred ministrations, they said that in the first place they felt a quaking, and heard a great noise, and after that they heard the sound as of a great multitude, saying, 'Let us remove hence.'"

I could point to many other features which Josephus has but too obviously plagiarised (hiding the theft with greater or less craft and skill) from accounts which must have reached him respecting Christ and His apostles. In particular, his account of Banus (a Baptist as the name implies) is manifestly borrowed from the account of John the Baptist. He describes further a man named Jesus, (not the Jesus who proclaimed woe to Jerusalem) who had friends called John and Simon, and followers who were chiefly fishermen and poor people. This Jesus, according to his account was betrayed by one of his followers, and deserted by the rest. Seventy followers he had, Josephus says, who went with him from city to city, while he heard cases and delivered judgments.

But space would fail me if I should attempt to indicate all the material apparently borrowed by Josephus with the "deliberate dishonesty" ascribed to him by Canon Farrar, from the Gospels and the Acts, or from accounts of actual events described in those records. One circumstance only I must add to those already dealt with. It would seem even as though Josephus had heard the actual details of the conduct recorded of another Josephus—to wit, Joseph of Arimathea:—for after claiming to be what Joseph of Arimathea was, "a councillor, a rich and just man," he states that having on a certain occasion been sent by Titus to a village called Thecoa, not very far from Jerusalem, he saw on his return, among other crucified persons, three whom he remembered "as former acquaintances." "I was very sorry at this, in my mind," he proceeds, "and went with tears in my eyes to Titus and told him of them; so he immediately commanded them to be taken down, and to have the greatest care taken of them, in order to their recovery; yet two of them died under the physician's hands, while the third recovered." This, he would know well, would be understood by all readers of his time to indicate clearly that the two who died had merited their punishment, like the two thieves, but that the third was innocent.

It appears to me that the only other explanation which can possibly be suggested for these multiplied coincidences, would be that the Gospels themselves, being written a century later, as the author of "Supernatural Religion" considers to be proved, came to include accounts which had been handed down by tradition, but related to actual events as recorded by Josephus. This is the explanation suggested by Mr. Solomon in his work "The Jesus of History and the Jesus of Tradition." But this explanation besides being inconsistent with accepted views respecting the authenticity of the New Testament canon, does not accord well with the conclusion of Canon Farrar that Josephus was a renegade and a sycophant,—deliberately dishonest in regard to events which had taken place in the lifetime of his father and had closed but a few years before his own birth. One or other explanation we *must* take, it would seem. In what sort of favour, by the way, Josephus stood with Titus, is perhaps sufficiently shown by his action with regard to his crucified friends,—as described by himself.

COAL.

By W. Mattieu Williams.

BITUMINOUS SHALES AND THE ORIGIN OF COAL.

THE trial and controversy concerning the Boghead or Torbane Hill mineral was instructive, would have been more so had the scientific witnesses been heard. Commercially it is coal, simply because it has been bought and sold under that name, was thus dealt with when the bargain under litigation was made, but, if we are to admit the existence of such a class of minerals as bituminous shales, it certainly belongs to this class, regarded from the point of view of scientific classification.

One experiment that was made in Edinburgh at the time, but of which no account appears to have been published, is, I think, decisive. A piece of boghead was carved roughly to the shape of a man's head. This was put into a fire, all its hydrogen and carbon burnt out, and there remained a solid lump of baked earthy matter still bearing the shape of the original lump. The original material was evidently a shaley rock, impregnated *somehow* with bituminous matter. I place special emphasis on this word somehow, as it presents an interesting problem which a sound theory of the formation of coal is bound to solve. Why have we in so many instances distinct seams of bituminous shale and of true coal so near together—in some cases in actual contact? The Leeswood cannel seam, for example, rests directly on a floor of shale, and is directly topped by a roof of shale, both black and bituminous. The products of distillation are the same of both shales and the two intermediate seams of cannel, but the shales leave behind masses of incombustible stone, the cannel lumps of combustible coke.

Still, in this classification, as in so many others, an absolute line cannot be drawn. Generally speaking, true coal leaves, on complete combustion, from $\frac{1}{2}$ per cent. to 3 per cent. of powdery ash. True bituminous shales leave a massive ash varying from 75 per cent. to about 15 per cent. Boghead leaves $21\frac{3}{4}$ per cent.; the top shale of leeswood above 75. Besides these we have questionable coal, leaving 10 per cent. or thereabouts of ash in lumps that crumble easily. Referring to Cleggs' table of the analysis of 198 varieties of British coal, I find 24 containing between 5 and 10 per cent. of ash; 21 between 3 and 5 per cent. Only two contain as much as 10 per cent., 9 contain less than 1 per cent., and 119 from 1 to 3 per cent.

I state these figures because they have an important bearing on the interesting question of the origin or formation of coal. They demolish at once the prevailing theory that a coal seam is simply an ancient forest or a woodland marsh that has been submerged and buried where it stood.

No such forest, no such marshy woodland as we see so prettily displayed in the fancy pictures of the vegetation of the coal period could be formed without soil for the roots of the calamites, the sigilariæ, the lepidodendra, the stigmariæ, the ferns, &c., to grow in. A single generation of such reeds and trees, if thus buried *in situ*, would form but a few inches of coal; to produce a seam, many generations piled one above another are required, and each demands a soil. Conifera, such as described, cannot grow one on the top of another, nor in the purely vegetable soil formed by the decay of their ancestors.

The quantity of ash contained in our most abundant coals leaves absolutely nothing to represent the soil. The average amount of incombustible ash contained in the roots, stems, and leaves of forest trees, shrubs, and herbaceous plants is actually in excess of that found in ordinary coal. Dried ferns contain above $3\frac{1}{2}$ per cent. of such ash; the leaves of beetroot (the ash of which is commercially used in the manufacture of potash) contains $10\frac{1}{2}$ per cent. Forest trees taken bodily, wood and leaves, vary from 1 to 6 per cent., the leaves always containing the most. Compare the ash left by a burnt cigar with that of a similar weight of coal when all the carbon is fairly burnt away. The calamites of coal measures represented by our "horse-tails" and "mare's-tails" have a siliceous scale armour, are exceptionally rich in ash. I have made microscopic preparations of these by burning a piece of the stem, and transferring the siliceous skeleton, without breaking it, to a glass slide, whereon it displays very beautifully the structure of the plant. Dried stems of such reeds are sold under the name of "Dutch rush," and used as natural files, for which purpose they are qualified by their flinty cuticle. I am unable to find any record of an analysis which gives the

percentage of ash in these plants, but will determine it myself, and state the result in my next paper.

I must here warn the reader against a fallacy usually implied, though not definitely expressed in our geological text books. Pictures are there shown of the calamites, the sigilaria and stigmaria, the lepidodendrons, tree ferns, &c., of the coal measures, and the reader who only learns from books, without actual field-work, concludes when Lyell tells him that "no less than 250 ferns have already been obtained from the coal strata" ("Elements of Geology," 5th edition, p. 467), that coal itself has been proved to be made of these, that ordinary coal is visibly composed of such fossil vegetation, and that the pictures represent fossil specimens found in the coal itself.

This is not the case; *ordinary* coal displays little or no definite vegetable structure. It is true that Professor Göppert found in certain samples of German coal indications of structure corresponding to the fossil plants known as those of the coal measures, but the fossils which are pictured and described in the books are those found in the rocks above or below the actual coal seams, not in the coal itself. Thousands of years may have elapsed, must have elapsed in some cases (such as the celebrated fossil tree in Cragleith quarry), between the deposition of the coal itself and that of the fossil plants in the other rocks. Great geological changes must have occurred in order that pure vegetable matter, deposited where it grew, should be succeeded in the same place by a subaqueous deposit of sandstone, fifty or sixty or more yards in thickness. All this sandstone was certainly formed under water, and that water must have been deeper than its own thickness. If the coal was formed on the land, it must have been submerged either by a great convulsion or a series of ordinary changes extending over a vast duration of time, before the great sandstone or shale deposit could be formed over it.

The same reasoning applies conversely to the fossils found in the rocks below the coal-seams. Many of the coal-fossil specimens in our museums have come from rocks that are as much as 100 ft. above or below any workable coal seam. I once collected a cart-load of fine specimens from the materials of a sinking in Flintshire which failed to reach the coal.

I do not, however, assert that vegetation corresponding to these fossils found in the rocks have not contributed to the formation of the coal itself, but that the conditions of their deposition were quite different from that of the coal seams, and that they represent only those particular species of plants that are capable of retaining their structure under the circumstances of deposition. In the rocks where these fossils occur there are ten thousand or more parts of mineral matter to one of vegetable matter. In the coal there are forty or fifty of vegetable matter to one of mineral—less mineral matter than is found, on an average, in living plants.

Lyell struggles with this difficulty by supposing that our coal measures have "originated in the manner of modern deltas." He says, "They display a vast thickness of stratified mud and fine sand without pebbles; and in them are seen countless stems, leaves, and roots of terrestrial plants, free for the most part from all intermixture of marine remains, circumstances which imply the persistency in the same region of a vast body of fresh water."

But how about the absence in the coal itself of this mud and sand, the mineral sediment which makes up the substance of ordinary "modern deltas"? The explanation offered by Sir Charles Lyell, who always reasons on the sound principle of explaining the unknown by the aid of the known, is derived from what actually occurs in the valley and delta of the Mississippi, where the dense growth of reeds and herbage which encompasses the margins of forest-covered swamps, "is such that the fluviatile waters, in passing through them, are filtered and made to clear themselves entirely before they reach the areas in which vegetable matter may accumulate for centuries, forming coal if the climate be favourable."

Here he supposes (as he states further on) that the coal was formed actually on the spot where the vegetation grew; this brings us back to the difficulty I have already stated—viz., the absence of the mineral matter demanded as soil for the plants. How many generations of trees would be necessary to cover the ground closely together so as to form a stratum only one tree deep? How many of such strata would be required to build up a coal-seam, like that of South Staffordshire, thirty feet deep, seeing the great condensation of original bulk which occurs?

Mosses may grow, do grow, in peat bogs upon the dead bodies of their ancestors; but forest trees and other higher vegetation cannot. In tropical forests, the trees that fall and the leaves that are shed vanish by slow combustion and the work of microbia and insects. Their carbon is converted into gaseous carbonic acid, and only their ash remains, just mingled with a residuum of humus sufficient to form an ordinary vegetable soil, which, if burnt, would leave seventy, eighty, or ninety per cent. of ash.

* * * * * *

Mr. Proctor's comments on my incidental reference to phlogiston and ether seem to imply, and must convey to his readers the impression, that I accept the corpuscular theory of light. I reply, in order to defend myself against such misunderstanding, which amounts in fact to a complete inversion of my views. I regard the corpuscular hypothesis of Newton, with its fits of easy transmission or reflection, as a physical superstition one degree more gross than that of the luminiferous ether, and equally gratuitous. This may appear very rude, and, therefore, to mollify a little, I will add that my views are not original, not new, not even modern. They were quaintly enunciated by a great philosopher, who died when Sir Isaac Newton was five years old.

Torricelli says, "La materia altro non è che un vaso di Circe incantato, il quale serve per ricettacolo della forza, e dei momenti dell' impeto"—"Matter is no other than an enchanted cup of Circe, which is the receptacle of force and momentum." He continues by saying that force and momentum can be contained in no other receptacle than the intimate substance of ordinary matter. To render this a precise expression of my own views, I will translate it freely into the language of modern science, when it stands thus:—*All the activities of matter reside in the substance of matter itself, and can be manifested and communicated only by such substance.*

MODERN ANALYTICAL CHEMISTRY.*

GIGANTIC as have been the strides in theoretical chemistry since the first enunciation of the Law of Avogadro in 1811, the analytical branch of that science may, we think, fairly claim to have progressed, *pari passu*, with the hypothetical one, and to have proved itself equal to any demands which have so far ever been made upon it. Very worthily

* "Select Methods in Chemical Analysis." By Wm. Crookes, F.R.S., V.P.S.C. 2nd Edit. (London: Longmans, Green & Co. 1886.)

does Mr. Crookes sustain his reputation in the fine volume before us, to the value and excellency of which probably no more appreciable testimony could be offered than that afforded by the fact that (addressing, as it does, a comparatively limited public) it has already run into a second edition. For this is by no means an ordinary text-book, exhaustively describing the everyday work of the general analyst, but rather a laboratory companion for the advanced chemist, containing information to be sought in vain in any of the numerous works usually employed by the student. Not that the processes described in such detail are of necessity in themselves difficult; some of them, in fact, being as remarkable for their simplicity as for their elegance; but easy or operose they one and all represent the latest developments of the science of analysis, and show how it may be conducted with the greatest certainty of attaining accurate results. The various methods of separating the metal Thallium, for example, from the substances with which it is most frequently found in combination, will interest all those who remember that the description of such methods are written by the man to whom we are indebted for the original discovery of the existence of Thallium itself. Very full directions, too, are given for the separation of others of the rarer elements. Some portions of Mr. Crookes's volume may fairly be described as indispensable to all engaged in the pursuit of chemistry; such, for example, as his elaborate directions for the rigidly-correct adjustment of weights, and his admirable *résumé* of various artifices in use in the laboratory, which appear near the end of the book. As an illustration at once of elegance of method and extreme delicacy of reaction, we would instance the account of some recent modes adopted for the detection of very minute quantities of iodine, given on p. 560 *et seq.* Assuredly this is a book without which no chemical library can be considered in any sense complete.

AN ENORMOUS GRANITE SLAB.—To separate from the main ledge a slab of granite 354 feet long, three to four feet thick, and eleven feet wide, is no ordinary feat to accomplish. But this has been done at the Flynt Granite quarry, in Monson, Mass., and by the means usual in all quarries for separating slabs or blocks from the main ledge. A row of wedges were set, several hundred in number, and the workmen beginning at one end gently and carefully tapped the wedges, moving by degrees down the line, until the other end of them was reached, when the same operation was repeated. In this manner, by careful and patient application, aided by favourable conditions of the weather, the slab of the above phenomenal size was successfully separated from the main rock. The value of this immense slab, if it could have been transferred safely to one of our large cities, at not too great cost, would have been several thousand dollars. And it seemed almost sacrilegious that it was necessary to cut it up into smaller blocks for transportation—and finally used for ordinary building purposes. The possibility of getting out a slab of such size without breaking it indicates that the grain of the Monson granite not only runs evenly, but that it possesses great tenacity.

ROYAL VICTORIA HALL AND COFFEE TAVERN, WATERLOO BRIDGE-ROAD, S.E.—The Penny Science Lectures will shortly recommence at the above hall. The following are promised:—Tuesday, Feb. 2, W. P. Bloxam, Esq., on "Fire, Fuel, and Illumination." Feb. 9, J. M. Thomson, Esq., on "Dirty Water and how to Cleanse it." Feb. 16, Professor George Forbes, on "Shooting Stars and Comets." Feb. 23, Wm. Lant Carpenter, Esq. March 2, T. C. Porter, Esq., on "English Cathedrals." March 9, Dr. J. A. Fleming, on "Niagara."

THE STORY OF THE EARTH.*

GEOLOGY shares with astronomy the interest arising from the study of the life of worlds. In the star-depths we see uncounted millions of suns of many orders,—in size, in structure, and in condition,—but each probably like our own in being the centre of its family of planets. In our sun we study the one star near enough to present to us the general features of sun-life. In the solar system we see many planets, divisible into different orders, whether we consider them in regard to size and mass, or to age and condition. And lastly in our own earth we study the one planet near enough to admit of being thoroughly examined as regards its present condition, affording evidence of great interest also as to its past state, and telling us much even of its probable future. It is not only true that the study of astronomy would be as incomplete without geology as the study of the stellar universe without the fullest inquiry into solar physics, but it may be said that in the study of the earth we have the fullest and most complete evidence respecting planetary orbs, bodies which probably outnumber many times the millions of suns throughout the universe.

Thus the student of astronomy, after examining the general evidence afforded in the star-depths respecting the nature and distribution of suns (our own sun being his sample star) and inquiring further into the general evidence afforded within our solar system respecting the nature and distribution of worlds, turns to his fellow-worker, the student of geology, to tell him all that has been learned about our own world, its present condition (in air, land, water, and beneath its crust), its past history and its probable future. The position of the two studies, astronomy and geology, has thus been completely altered from what it was in past ages, when men in no sense regarded our earth as one among the bodies circling round the sun, or the sun, moon, planets, and stars, as orbs comparable with the earth in importance. Then the study of astronomy was chiefly important as throwing light on the nature of the orbs fashioned in the beginning to serve the earth, to be her light by day and her light by night, to be for signs and for seasons, and for days and years. It would have seemed inconceivable in those days that the time would ever come when the sun and moon, the stars and the planets, would in part be studied for the information which they can throw upon the present constitution, the past history, and the future fate of the earth, in those days regarded as infinitely more important than any of the heavenly bodies. It would have been equally inconceivable, also, that the earth would ever be studied for the information it could give as to the heavenly bodies, then regarded as entirely different from the earth in nature.

The study of the earth by the geologist is necessarily associated with the study of other worlds by astronomers. As Mr. Geikie remarks in the admirable work which is now before us (in a new and improved edition) "whatever is ascertainable by telescope, spectroscope, or chemical analysis, regarding the constitution of the other heavenly bodies, has a geological bearing." In particular, it is important to the geologist to inquire whether the various orbs forming our solar system (the only region where we can look for actual worlds) are all alike, in constitution and condition. If he shall find reason to think they are

* "Text-Book of Geology." By Archibald Geikie. Second Edition. (London: Macmillan & Co.)

quite unlike then he has to inquire in what respects they differ. They may be formed of very different materials, or of the same materials, or of the same materials differently proportioned; or they may be formed of similar materials similarly proportioned but in different states; or differences of all these kinds may coexist. It is unfortunate, we think, that Mr. Geikie has not sufficiently considered this general question, in the light of the most advanced modern inquiries, but has adopted the crude idea, derived in part from misapprehension of Laplace's nebular hypothesis (itself but a crude guess) in part from ignorance of the laws of physics, that the evolution of our system has led to the lighter materials finding their place in the outer planets, the heavier in those near the sun. We feel justified in saying that no astronomer now holds this opinion as even probable; while we can hardly imagine that even those who, not being astronomers, have made more or less incomplete inquiry into the matter from its chemical side, can regard the idea as more than a mere guess. Astronomically, the idea is untenable, it is opposed to the known laws of physics (for instance, the law of gaseous diffusion), while the chemist who considers the relative position of the hydrogen and the oxygen or nitrogen in our earth, will assuredly reject the idea that the lighter elements necessarily tend to the outside even in single orbs—the idea that they do so in systems of orbs formed by processes of aggregation or condensation being still wilder.

Mr. Geikie's mistake, here, is unfortunate, because it deprives him at the outset of all the light he might have derived from the consideration that there may be among the planets orbs telling of the influence of various peculiarities of structure on the progress of a planet's life-history, while there may be other orbs telling of the features characterising the various stages through which our earth itself has already passed or may have to pass hereafter. For example, we have in our moon an orb which has probably, owing to its smaller mass, had much smaller seas, much rarer air, and also much shorter life-stages than the earth; while gravity at the surface on which so much of the activity of denuding and restorative forces depends, has been but one-sixth on the moon what it has been on the earth. So that we are justified in looking on the moon for traces of the effects of those vulcanian activities which are at work in the earlier history of every planet but the effects of whose work on our own earth has long since been removed by the denuding forces of air and water. On the other hand, we are justified in expecting to find certain products of denuding action by sea, river, rain, wind, storm, ice, snow, and so forth—as mountain ranges themselves for instance—less plentiful in the moon than on the earth. Studying the moon then, we may say that because such and such features are more common on the moon than on the earth they probably belong to the earlier stages of vulcanian activity, and that because such and such features are less common on the moon than on the earth, they may probably be regarded as in the main products of denudation. Or slightly altering our point of view, the men who first studied the moon with the telescope, might had they had the general doctrine of evolution to guide them, have said that, because there are hundreds of great craters on the moon and comparatively few on the earth, therefore the more active denuding forces of the earth must have destroyed her great craters, whose wrecks however we may profitably search for; and on the other hand because mountain ranges are a much more marked feature of the earth than of the moon, the great ranges are probably the work of denudation, and we may profitably examine the structure of the Alps, the Himalayas, the Rocky Mountains, and so forth, for the evidence that, lofty though they now are, they have been formed by processes of sedimentary deposition in great trough-like depressions beneath former seas.

So with those planets which like the giants Jupiter and Saturn seem to tell us of earlier stages of planetary life. Those orbs may be profitably studied to throw light upon that past stage of the earth's history when the seas once formed a portion of her atmosphere, along with oxygen and nitrogen in many times greater amount than at present, with carbon dioxide (our former friend carbonic acid gas) in enormous quantities, with sulphurous acid, sulphuretted hydrogen, chlorine, boracic acid, sodium vapour, magnesium vapour, and other components, probably raised to enormous distances from the planet to which they were thereafter to belong by repulsive forces akin to those which act upon the vaporous material of comets' heads.* If we can recognise among the planets some which are younger than our own earth, we may be able by studying such orbs, to see our way to the recognition of our earth's state when as yet there were neither oceans nor continents.

It may perhaps be that Mr. Geikie's failure to recognise the obvious bearing of many of the most interesting astronomical researches of our time upon geological problems, has been the reason why he has left almost untouched some subjects of geological inquiry which have greatest interest for students of astronomy—as for example the history of mountain ranges as studied by some of the leading geologists in Germany and America, the question of the primeval condition of the air and sea, and the inquiry into the probable future effects of changes now in progress upon and within the earth. His study of astronomical evidence on such matters as these is limited to the inquiries—highly important no doubt in themselves—which astronomical physicists have made into the earth's own condition and probable past, inquiries in which we see astronomers dealing with geological problems rather than studying astronomical matters in such sort as to throw light on geology.

But if there is some shortcoming in this respect and Mr. Geikie has not been fortunate in his study of astronomical evidence, it may safely be said that in no other respect can any fault be found with this splendid treatise. So soon as we enter on the strictly geological matter, we find a combination of the most studious research with admirable literary qualities. The book is a student's treatise of the most thoroughgoing sort, while at the same time it is a work which every one who takes interest in the teachings of science will thoroughly enjoy. The student cannot spare one paragraph of the charmingly written passages in which the results of geological teaching are presented for general reading; and though the general reader need not be at the pains to study all the details collected for the special use of the student, yet these are so arranged that he has no trouble in knowing what to omit.

All the divisions of the work are well done; but the division relating to what Mr. Geikie calls Stratigraphical Geology, the record of the earth's crust (that great volume of Nature's Bible) as to material life and as to the varied forms of vegetable and animal life which have successively prevailed on the earth, is especially valuable. Complete (so far as on the scale even of so large a book

* In some such way only can the apparent inconsistency between the observed depths of the gaseous and vaporous envelopes of the giant planets (or of the sun) and the laws associating density and pressure of gases and vapours, be removed or explained.

as this such a record can be complete) for the most conscientious student, it has all the interest of a grand romance for the reader who not being a student of geology takes thoughtful interest (as every cultured person must) in the results of scientific research.

We shall return, and more than once, to the subjects dealt with in the various divisions of this work. In the meantime we commend it warmly to those among our readers who have not yet seen it. Those who have will need no recommendation. The new edition has been much enlarged, and carefully brought up to date in regard to geological and palæontographical matters. The book might well bear the title which heads this paper. When shall we have a "Story of the Heavens" as well done?

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

COLOUR AND LIGHT.

NOW, before proceeding any further, we must stop to caution the student that the theory of three primary colours expounded in our last chapter is, and can be, only what the metaphysicians call "subjectively" true: in other words, it is only so as regards *our own sensations*. A very little thought will suffice to show that, externally to ourselves, there can be no such thing as three elementary kinds of coloured light; for, from what has preceded, it must be obvious that many hundreds of different tints are existent in the spectrum—each with its appropriate wave-length—to say nothing of the waves at both ends of it, which fail to affect our vision at all. Once more, then, light consists of nothing but a series of undulations or vibrations, the length and frequency of which, when they impinge on the retina, affect us with the various sensations of colour. We know that when the rays of the sun fall upon the nerves of sight we are affected with the sensation of light; whereas the identically same rays, exciting our nerves of touch, produce in us the sensation of heat. And so in Young's theory, all that is postulated is that the difference of our sensations of colour has its origin in the *kinds* of nervous fibres which are excited. When all three kinds are equally stimulated we see what we call white light. Colour, in the sense in which we know it, can have no existence whatever outside of ourselves; though the actual waves in the æther of every conceivable length, of course, both can and do exist. With this qualification, then, we will resume the thread of our description.

We said on page 96 that red and greenish blue, orange and a greenish blue, bright blue and bright yellow, and greenish yellow and violet light, when mixed in the indicated pairs, all four give white light as a result. It will, then, only seem natural that if, by any means, we subtract one of these colours from white light, the other, its so-called "complementary" colour, will remain; and this we shall find to be the result of direct experiment. Now, an accurate knowledge of what these complementary colours severally are is of the greatest practical importance to the artist, since, as we shall find, they afford the very strongest contrasts that it is possible to obtain, when placed in juxtaposition. One of the most simple methods of obtaining truly complementary colours is by the aid of the polariscope and thin films of selenite. Another way, by a system of trial and error, is to employ the double-image prism shown in Fig. 8 (p. 96), at P. Placing a parallelogram of paper coloured of the tint whose complement we wish to obtain on a dead-black ground, we paint a similar piece of what we suppose should be the complementary colour; and, laying it by the side of our first piece, cause their duplicated images to overlap by regarding them through our prism. If the resulting image be not white (or rather, using coloured paper pure grey), we see what colour predominates, and suppress this if it leaves our first tint outstanding, and *vice-versa*, until we hit upon a shade which exactly neutralises our first one. Or, preferably, we use Maxwell's discs (Fig. 6, p. 95), because from their construction they enable us to add more than one colour to our compensating sector, and so ultimately to obtain a mixture that shall, with our original one, accurately make up white—or, as we have said above, pure grey—light. Suppose, for example, that we wish to find the complement of the crimson of the spectrum, we shall discover that neither blue nor bright green will serve our purpose, but if we add a green sector of the proper size to our blue one, we shall find that the two in combination will neutralise our crimson, and produce white light (or its equivalent, in our apparatus, pure grey). In the same way a purple truly complementary to green may be arrived at, and so on. Or, finally, there is the rough-and-ready method hinted at at the conclusion of our last paper—that of tiring the retinal nerves out by gazing intently at any given colour, and then turning the eye towards a white surface; from which the temporarily colour-blind retina will select the colour to which it is fresh. Almost every one, we suppose, has tried this experiment in the form of staring at a red wafer on a white sheet of note-paper, and suddenly removing the wafer, when the spot it occupied on the paper will appear as a green one. The explanation of this, after what has preceded, must be obvious. The spot on the retina on which the image of the wafer has fallen has become tired out as far as red light is concerned; and when the exciting red image is suddenly withdrawn and the spot it occupied is filled with white light, the fatigued nerve fails to detect the red element in the white light, but picks up the green one readily enough. In a similar fashion if we steadily regard a well-lighted brightly-coloured picture for some time and then turn the eyes rapidly towards the ceiling we shall see its "after-image" in complementary colours. A striking way of showing the existence of retinal fatigue is to put a sheet of note-paper on a dark background and cover half of it with a piece of dead-black card, fixing the eye steadily upon a point about the middle of the boundary of light and darkness. The paper should be well lighted. After gazing at this arrangement for a minute or two, if the black card be suddenly removed, that half of the paper which is previously covered will seem very notably brighter than the other one which has been continuously under observation.

We have now seen how the sensation of white light is produced by the excitation of all three of the retinal elements whose vibrations produce in our brain the sensations of red, green, and bluish-violet, or violet-blue; and further, how a very considerable range of the multitudinous colours observed in nature is producible by the mixture of these primary colours in various proportions. Considerable however as this range of colours is, it is very far indeed from exhausting all the tints and hues we behold around us, which, at first sight, it seemingly should do, were the colours we have specified really ultimate ones. But, so far, we have proceeded on the assumption that their action on the eye never varies,

and that as long as we can see them at all, their distinctive tint remains invariable. A very little reflection will suffice to show that this is not the case. Take, as an illustration, a soldier's coat (let us say an officer's, inasmuch as "Tommy Atkins's" tunic is not always of the very brightest or best dyed cloth). If we regard this in brilliant sunshine it will look quite orange-coloured, as compared with its scarlet tint as seen by the light of an ordinary white cloud; while, as evening draws on, the red gets darker and darker, until it becomes almost indistinguishable. It is noteworthy that the intense red of carmine is much less affected by darkness. Green, when in the full glare of sunlight, becomes a yellowish green, and even a kind of pale yellow. Violet, in the same way, becomes blue and even blue-grey; darkening, as in the case of red, as the illumination is decreased; but, unlike red, continuing to show as violet as long as any light falls on it at all. All this may be prettily shown by making a little bouquet of scarlet geraniums, pansy ("Purple King" answers well), and any bright green leaves, and studying the seeming change in the tints of its components by viewing them first in brilliant sunshine, then in ordinary daylight, and finally in a darkened room. From all this we shall gather that we have not only our three primary colours in their normal state to deal with in forming compound ones, but that we have an indefinitely large series producible by mixing white light with them, as also by altering their luminosity. This may be well illustrated by using our Maxwell's discs, employing a plain white one to mix white light with the colour to be tested, and a dead-black one to degrade its luminosity. Suppose, for example, that we take a disc painted with chrome yellow. If we combine this with a white one, on rotating the combination rapidly on our whirling table, it will be seen to exhibit a decidedly orange hue. If now we exchange our white disc for a black one, we shall find the resulting colour will be an olive-green. This is very striking, and cannot fail to impress the student with the large range of tints producible by mere change in luminosity. He is strongly urged to prepare a series of discs as purely and brilliantly-coloured as he can produce them, and try for himself the results of their combinations with the simple black and white ones.

Now, it might reasonably be supposed that if any given colour changes so manifestly under varying illumination, the difficulty of judging of it would be well-nigh insuperable. In practice, however, as Helmholtz points out, we find that we are able to judge of local colour without either uncertainty or hesitation, under the most diverse conditions. Thus, white paper in full moonlight is darker than black satin in daylight, but we never have the smallest difficulty in recognising that the paper is really white and the satin black; though, at the same time, a brilliantly-illuminated grey surface may appear identical in colour with a white one in shade. By throwing a strong beam of light (by the aid of a lens) on to a grey disc whose diameter is the same as that of the beam, the disc will appear perfectly white. This is most strikingly shown by mounting the circle of grey paper on a sheet of white cardboard illuminated by diffused light. A notable result of the diminution of the intensity of light is to practically reduce the spectrum to the three colours red, green and violet. If the light be still further diminished, the violet disappears, the red turns to a kind of chocolate colour, and the green is seen as a pale green. Finally if we continue to reduce the light passing through our prism, the chocolate colour vanishes, and the green alone remains, itself to turn to a sort of grey before the ultimate extinction of the light altogether. We are indebted to Von Bezold for this curious experiment. Here we get a glimpse of the origin of such colours as brown, which, of course, have no existence in the ordinary spectrum; and we may further illustrate their production by attaching not a whole Maxwell's disc to the axis of our whirling table, but a simple card sector painted with vermilion, and placing a sheet of dead-black paper behind it as a background, prior to setting the sector in rapid rotation. The effect of this arrangement on the eye is that of a circle of rich chocolate-brown colour.

We have seen, then, that the juxtaposition of complementary colours sensibly heightens and intensifies them; and that any considerable increase or decrease in their illumination also causes the most marked apparent changes in their hues. We may now say a few words as to the practical application of the principles we have been endeavouring to explain. To the artist the knowledge of these principles is, of course, simply indispensable. If, then, we wish in, say, a water-colour sketch to make any given colour "tell" to the utmost, we must contrive to oppose its complementary colour to it. Let the reader get a sheet of blue and a sheet of yellow paper, and out of the latter cut two squares or discs. Now, let one of these be laid upon the sheet whence it was cut, and the other on the blue sheet, and regarded side by side. It will not be easy at first for the observer to persuade himself that they are identical in colour, so much more brilliant will the disc appear which is superposed on the blue sheet. Or, again, he may perform a modification of the experiment of Helmholtz, described on p. 97, and providing himself with a sheet of red paper, place upon it a disc of bluish green, and regard the latter steadily for a minute or so. If, now, an assistant will suddenly blow it away, the space which it occupied will appear of a decidedly more intense red than the rest of the sheet, for a reason with which the student is by this time familiar. In Barnard's "Landscape Painting in Water Colours" will be found a series of diagrams of a grey pattern on variously-coloured backgrounds which are very instructive. Or better still, we may go direct to nature herself, and notice the glorious contrast of an orange-red sunset with the vivid purple of distant hills behind which the sun is descending; the distinctly green tint of the moon as seen against one of the lovely rosy-"afterglows" which have prevailed in various parts of the world since the beginning of 1883, and so on. Moreover, as we have seen how much paler colours become when very brilliantly illuminated, green, for example, looking almost yellow in the glare of the sun, we hence get a hint as to the most natural method of painting any brilliantly-illuminated landscape, *i e.*, to impart a yellow tone to the bright lights. The careful observer of nature, too, will note how the prevailing colour of the source of illumination of a landscape affects those of the shadows cast by the various objects in it. And, in connection with the colours of shadows, by the way, a very curious and instructive experiment may be made without much difficulty by any one who can command the use of a room with a single window, closed by a shutter in which a small aperture has been perforated. Through such aperture we admit the daylight reflected from a bright white cloud, and setting up a rod (a broomstick will do) in the middle of the room, in the path of the rays; its shadow must be made to fall upon the opposite wall of the room, if white; or, in default of this,

on a tightly-stretched white sheet, or large sheet of cardboard. Under these circumstances it will appear grey. Now, though, let us light a candle. This will also illuminate our white background, of course, with a yellowish light, and will cast a second shadow of our rod, which should be made to fall a short distance either to the right or left of our shadow number one. Care should further be taken by varying, if necessary, the size of the hole through which the daylight comes, to render the shadows equal in intensity. Under these circumstances, the rod cutting off the light of the candle from that part of the wall or screen upon which its shadow falls (and which is thus illuminated by daylight alone) should, theoretically, leave it white; but, owing to the effect of contrast, it will appear quite perceptibly blue; what we may call the daylight shadow of the rod seeming to be of a yellowish colour, as might be expected from the fact that it is illuminated by the yellow candle-flame. A very remarkable addition to this experiment was devised by Helmholtz, who viewed the inner edges of the two shadows—and, of course, the intermediate strip of the illuminated field—through a tube blackened internally, and gazed at them until the second shadow exhibited its most pronounced blue tint. Then he moved the tube until this shadow filled the field of view, when, curious to relate, although the yellow field, to the original contrast with which the seemingly blue colour was due, had now disappeared, the opening of the tube still seemed to be filled with bluish light. Nay, what appears still more surprising, upon blowing the candle out, the impression of blueness remained, albeit it vanished at once on removing the tube and looking straight at the screen. Here, evidently, the illusion must be in our own judgment, irrespectively altogether of any specific action on the nervous fibrillæ of the retina. Variations of this curious and really startling effect may be made by having two holes in the shutter with which we darken the room, and covering them with differently-coloured glasses or sheets of coloured gelatine. Another experiment, made with even less trouble than the one just described, was contrived by Mayer, who upon a sheet of bright green paper placed a small rectangle of grey paper. Gazing at this the green will look green and the grey grey, the effect of contrast being almost imperceptible. If, though, we cover the whole arrangement with a thin piece of tissue-paper, the green is notably diluted and weakened, and our grey slip of paper at once puts on a distinctly reddish hue. From this we derive a rule of considerable value to the artist—viz., that pale tints in juxtaposition exhibit the effect of contrast much more vividly than absolutely pure, strong ones do. Furthermore, it will be found that if we place in contact two rectangles of paper coloured identically save that one is pale and the other deep in tint, the pale slip will look paler, and the darker slip darker than when they are viewed apart. The best way to show this is to cut two such pieces out of each sheet; lay one from each piece together, and the remaining two, at some distance apart, upon a table, and look at them. The effect of proximity in seemingly altering their hues will strike the eye at once. Finally, the result produced by the mere contiguity of differently-shaded surfaces may be instructively shown by colouring a series of cards with absolutely flat washes of Indian-ink or lamp-black, each one darker than its predecessor. Laying these one over another, they almost suggest the idea of a fluted column, so much darker do the light ones appear where they are in contact with lighter ones still, and *vice-versâ*. This effect is seen on a grand scale in North Wales and other mountainous countries, where the landscape so often contains range after range of mountains up to the horizon. The slightest attention will show that the lower parts of any one of these ranges invariably seems lighter than the upper part of that immediately in front of it; and it must be always so represented in a sketch, if an accurate reproduction of the natural effect is aimed at. In fact, it will be observed that the sharp dark edge of any visible object lightens, quite notably, that part of a more distant one immediately behind it. The effects of contrast further produced by the superposition of colours upon black, white, and grey backgrounds, or by contact with masses of them, will be best learned from a series of experiments by the student himself. A very little thought will enable him to apply the principles we have been endeavouring to make clear, to the explanation of the phenomena which he will observe.

NOTES ON EARTHQUAKES.

By Richard A. Proctor.

THE EARTHQUAKE OF CALABRIA.

NO earthquake has ever happened, the circumstances attending which have been so carefully noted as in the case of the earthquake of Calabria in 1783. This celebrated earthquake began in February, 1783, and lasted until the end of 1786. The first shock threw down, "in two minutes, nearly every house in all the cities, towns, and villages, from the western flanks of the Apennines in Calabria Ultra to Messina in Sicily, and convulsed the whole country." The second took place seven weeks later, and was scarcely less violent. Sir Charles Lyell mentions that "the great granite chain which passes through Calabria from north to south, and attains the height of many thousand feet, was shaken but slightly by the first shock, but rudely by those which followed."

The manner in which a large extent of country was permanently affected by this earthquake is very well worth noticing, as affording an excellent illustration of the mode in which earth-waves travel.

The Apennines are formed for the most part of massive and hard granite, with steep inclines, upon the base of which lie those strata of sand and clay which form the Calabrian plains. These plains are usually level, but are intersected in places by narrow valleys and ravines whose sides are almost vertical. The effect of the earthquake was to *shake down* those parts of the Calabrian plains which border on the granite backbone forming the Apennine range. The soil "slid over the solid and inclined nucleus, and descended somewhat lower," says Lyell, "leaving almost uninterruptedly from St. George to beyond St. Christina—a distance of from nine to ten miles—a chasm between the solid granite nucleus and the sandy soil. Many lands slipping thus were carried to a considerable distance from their former position, so as entirely to cover others; and disputes arose as to whom the property which had thus shifted its place should belong to."

The whole of the country over which the effects of the great shocks extended was at times heaved simultaneously, like an angry sea, and sensations resembling sea-sickness were experienced by many of the inhabitants. Those who have watched the sky from the deck of a sea-tossed ship will have noticed that the drifting clouds seem at times to be arrested in their motion; it is in reality the ship which is moving for the moment in the

same direction as the clouds, and thus neutralises the effects of their motion. The same phenomenon was observed during the Calabrian earthquake; and nothing serves to give us a stronger impression of the turbulence of those internal heavings which make the dry land as unstable as the billows of a swelling sea. Trees whose roots continued firmly embedded in the soil were seen to lash the ground with their branches.

It will be evident that the seat of disturbance was beneath the rocky ribs of the Apennines. The superincumbent soil was swayed with violence by the vibrating mountain-slopes. But the chief mischief followed when the vibration ceased. For then the soil to which motion had been communicated began to slide over the now stationary granite, and this sliding motion being quickly checked by the irregularities of the rocky substratum, there resulted a destructive shock to all objects—houses, trees, or living creatures—upon the shaken plains. One may illustrate the nature of the shock as follows:—Suppose a small table-cloth to be lying on a large table with raised edges, and that a variety of objects stand upon the cloth. Then, if the table be shaken with a gradually increasing violence, these objects may continue in safety, provided the motion is so managed that there is no abrupt change of direction, and no sudden increase or diminution of velocity. If the motion of the table be suddenly checked, the cloth would not immediately lose its motion, but would slide till it was stopped by the raised edge of the table; and objects on the cloth would move with it, until its motion was checked, when they would receive a shock more likely to be destructive than any which had been communicated to them while the motion of the table continued. And just as such a cloth would "rumple up," as soon as the motion of one end was checked, so the soil of the Calabrian plains was found to be in some parts abnormally raised, in others as strangely depressed. "In the town of Terranuova," says Sir Charles Lyell, "some houses were seen uplifted above the common level, and others adjoining sunk down into the earth. In several streets the soil appeared thrust up, and abutted against the walls of houses; a large circular tower of solid masonry, part of which withstood the general destruction, was divided by a circular rent, and one side was upraised, and the foundations heaved out of the ground."

As might be expected, the soil did not continue unbroken by the violent shocks to which it was subjected. In the central parts of the disturbed region, the earth opened so widely as to swallow up large houses. In Cannamaria many buildings were "completely engulphed in one chasm," insomuch that not a trace of them was ever seen afterwards. So violently did these chasms close their yawning jaws, that afterwards, when excavations were made for the recovery of valuables, the workmen found the contents of houses crushed into a compact mass with detached portions of masonry. In some instances persons were engulphed by one shock and thrown out again alive by the following one.

The magnitude of some of the fissures which were formed during this earthquake affords startling indications of the tremendous violence of the earth's internal throes. Grimaldi observed in the territory of San Fili a newly-formed ravine half-a-mile long and twenty-five feet deep, and another of similar dimensions in Rosarno. In the district of Plaisano three enormous fissures were formed: one a quarter-of-a-mile long, about thirty feet in width, and 225 feet deep: the second, three-quarters-of-a-mile long, 150 feet broad, and 100 feet deep; and the third, *nearly a mile long*, 105 feet broad, and thirty feet deep.

If any evidence were required as to the true nature of the disturbance, it would be found in the remarkable motions of masses slightly attached to the surface-soil. Paving-stones were flung into the air, and masses of loose soil flung in showers over the surrounding objects.

In this earthquake 40,000 persons are supposed to have perished, and about 20,000 by the epidemics which followed. Dolomieu gives a painful account of the appearance of the Calabrian cities. "When I passed over to Calabria," he writes, "and first beheld Polistena, the scene of horror almost deprived me of my faculties; my mind was filled with mingled horror and compassion; nothing had escaped; all was levelled with the dust: not a single house or piece of wall remained; on all sides were heaps of stone so destitute of form that they afforded no idea of there having ever been a town on this spot. The stench of the dead bodies still arose from the ruins. I conversed with many persons who had been buried for three, four, or even five days; I questioned them respecting their sensations in so dreadful a situation, and they agreed that, of all the physical evils they endured, thirst was the most intolerable; and that their mental agony was increased by the idea that they were abandoned by their friends, who might have rendered them assistance."

The destruction of the Prince of Scilla and a great number of his vassals, was one of the most remarkable events attending this deplorable catastrophe. He had persuaded his servants to seek their fishing-boats for safety, and went with them to encourage them. During the night of Feb. 5, while they were sleeping, an enormous mass of earth was flung from Mount Jaci upon the plain near which the boats were moored. Immediately the sea rose more than twenty feet above the level of the plain. Every boat was sunk or dashed upon the beach, and hundreds of persons who had been sleeping on the plain were swept out to sea. The Prince and 1,430 of his servants perished.

EARTHQUAKE AT RIOBAMBA.

One of the most remarkable earthquakes ever experienced was that which overthrew Riobamba on Feb. 4, 1797. A district 120 miles long and 60 broad was shaken by an undulatory motion which lasted for four minutes, and a far wider district felt the effects of the disturbance. Within the space first named, in which the movement was more energetic, every town and village was levelled to the ground; and many places were buried under large masses flung down from the surrounding mountains. Among these was the flourishing town of Riobamba. Preceded and accompanied by no warning noises whatever, the terrific concussion in a few moments effected the complete desolation of the unhappy district. The earthquake was a singular combination of perpendicular, horizontal, and rotary vibrations. So violent was the perpendicular, or as it may be termed the explosive movement, that hundreds of the wretched inhabitants were flung upon the hill La Culla, several hundred feet high, on the further side of the small river Lican. Then came a horizontal movement, so rapidly succeeding the other that in many instances the furniture of one house was found beneath the ruins of another. In some cases property was removed so far from its original place, that disputes arose among the survivors of the catastrophe, and the Audiencia, or Court of Justice, was for some time occupied in adjusting these difficulties. Not less remarkable were the effects of

circular or rotary concussions. Walls beyond the town were twisted round without being flung down; rows of trees which had been parallel were deflected in the most remarkable manner; and the direction of the ridges of fields covered with various kinds of grain was observed to be altered by the effects of the earthquake.

Humboldt, it may be mentioned, explains in a somewhat unnatural manner the peculiar effects we have spoken of above. He conceives that the fact of the furniture of one house being found under the ruins of another, seems to show that the movement was first directed downwards, then horizontally, and then upwards. This appears to me wholly improbable. In the first place it has been almost constantly observed that the upward motion (in earthquakes which exhibit perpendicular vibrations) precedes the downward; and secondly, had the downward motion taken place first, it seems most probable that neighbouring houses would have sunk *side by side*, so that the following horizontal movement would only have resulted in the forms of destruction ordinarily observed in earthquakes. The more natural view seems to be that there was first a violent upward movement, flinging the less firmly built houses bodily upwards, and merely destroying others; then immediately followed a downward movement and a horizontal one, bringing the latter class of houses beneath the falling ruins of the others. Or it may be that so violent was the first upward movement, that the upper parts of all buildings were flung into the air, whence—not partaking in the horizontal movement which displaced the foundations and lower part of the houses—they fell in ruins over the *débris* of buildings they had not belonged to originally. An upward, followed by a downward, and then by a horizontal movement, might result in either form of demolition, or in both.

A short time after the destruction of Riobamba, a fearful subterranean rumbling, resembling the loudest thunder-peals, was heard under the cities of Quito and Ibarra, the former more than a hundred miles from Riobamba.

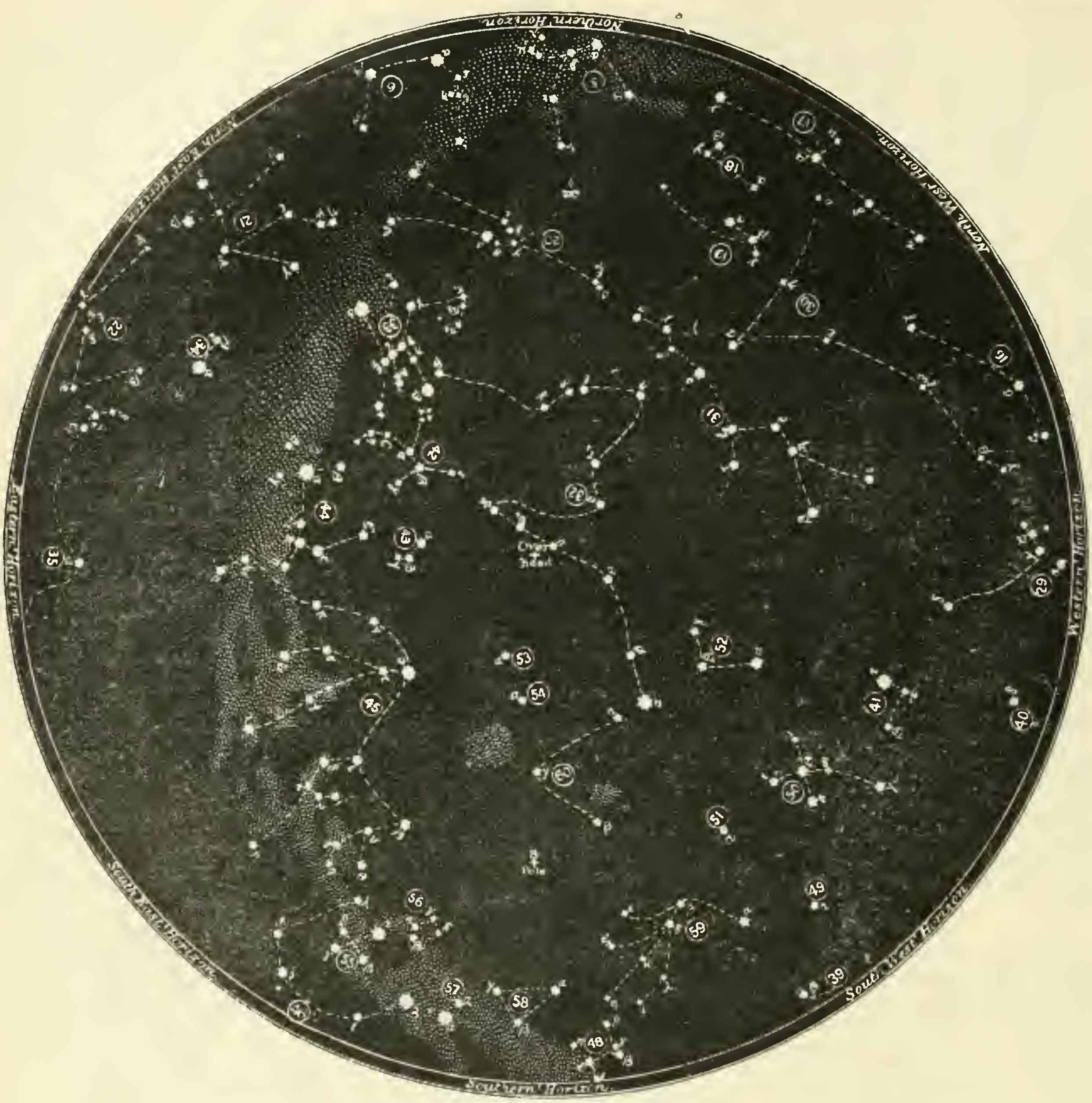
EARTHQUAKE NOISES.

The subterranean noises heard during earthquakes are sometimes singularly striking. The nature of the noises is very various, says Humboldt, "rolling, rattling, clanking like chains, occasionally like thunder close at hand; or it is clear and ringing, as if masses of obsidian or other vitrified matters were struck in caverns underground." These noises are not only heard much farther off than they could be if they were transmitted in the air, but they travel much more rapidly. In 1744, when the great eruption of Cotopaxi took place, subterranean noises were heard at Honda, on the Rio Maddalena. The crater of Cotopaxi, 17,000 feet above the level of Quito, is separated from it "by the colossal mountain-masses of Quito, Pasto, and Papayan, by innumerable valleys and precipices, and by an actual distance of no less than 500 geographical miles." The eruption which took place in the island of St. Vincent on April 30, 1812, produced subterranean noises resembling the loudest peals of thunder in Caraccas, in the plains of Calabozo, and on the banks of the Rio Apure, a distance of upwards of 700 geographical miles. "This, in respect of distance," says Humboldt, "was as if an eruption of Mount Vesuvius were to be heard in the north of France."

But it is remarkable that subterranean rumblings and bellowings are sometimes heard when neither an earthquake nor the kindred phenomenon—a volcano—is in progress. "Sonorous phenomena," Humboldt tells us, "when accompanied by no perceptible shocks, leave a remarkably deep impression even with those who have long dwelt in districts subject to repeated earthquakes." A singular instance occurred in the year 1784, in the high lands of Mexico. A sound was heard as of heavily rumbling thunder alternating with sharp explosive bursts beneath the feet of the startled inhabitants of Guanaxato. The subterranean bellowings and thunderings (*bramidos y truenos subterraneos*) grew gradually more and more intense, and then decreased as gradually. Terrified by a phenomenon which seemed to forewarn them of an approaching and terrible catastrophe, the inhabitants fled from the town, leaving great piles of silver bars a prey to bands of robbers. But after a time the more courageous returned and repossessed themselves of their treasure. For one month the subterranean grumblings were heard at intervals, though neither on the surface of the earth, nor in the silver mines 500 yards beneath it, was any movement of the earth perceptible.

THE EARTHQUAKE AS A RESTORING POWER.

We are so in the habit of regarding the earthquake as an agent of destruction, that it may sound paradoxical to assert that the phenomenon is surpassed by no other as a regenerative and restorative agent. Yet this is strictly the case. But for earthquakes our continents would continually — however slowly — diminish in extent through the action of the sea-waves upon their borders, and of rain and rivers on their interior surfaces. "Had the primeval world been constructed as it now exists," says Sir John Herschel, "time enough has elapsed, and force enough, directed to that end, has been in activity, to have long ago destroyed every vestige of land." It is to the reproductive energy of the earth's internal forces that we are alone indebted for the very existence of dry land. To the same cause, undoubtedly, we owe that gradual process of change in the configuration of continents and oceans which has been for ages and still is in progress—a process the benefit derived from which cannot possibly be called in question. Our forests and our fields derive their nourishment from soils prepared, for long ages, beneath the waves of ocean; our stores of coal and of many other important minerals have been in like manner prepared for our use during the long intervals of their submergence; we build our houses, even, with materials many of which owe their perfect adaptation to our wants to the manner in which they have been slowly deposited on what was once the bed of ocean, and compressed to a due solidity and firmness of texture beneath its depths. If it is indeed true, as Humboldt asserts, that "the destiny of man is in part dependent on the fashion of the outer crust of the globe, on the partitioning of continents, on the direction of the mountain chains which traverse them, and on the distribution of land and water," then we must look upon the earthquake as the most important of all those agencies which tend to the renovation of our terrestrial globe. So far from dreading lest the earth's subterranean forces should acquire new energies, we ought rather to fear lest they should lose their force. We may, therefore, gladly hail the opinion of the great geologist who asserts that "the energy of subterranean movements has always been uniform as regards the *whole* earth. The force of earthquakes," adds Lyell, "may for a cycle of years have been invariably confined, as it is now, to large but determinate spaces; gradually, however, this force shifts in position, so that other regions, for ages at rest, become "in their turn the grand theatre of action."



1. THE NIGHT SKIES IN AUSTRALASIA:—
At 9 o'clock January 7; at 8.30 o'clock January 14; at 8 o'clock January 22.

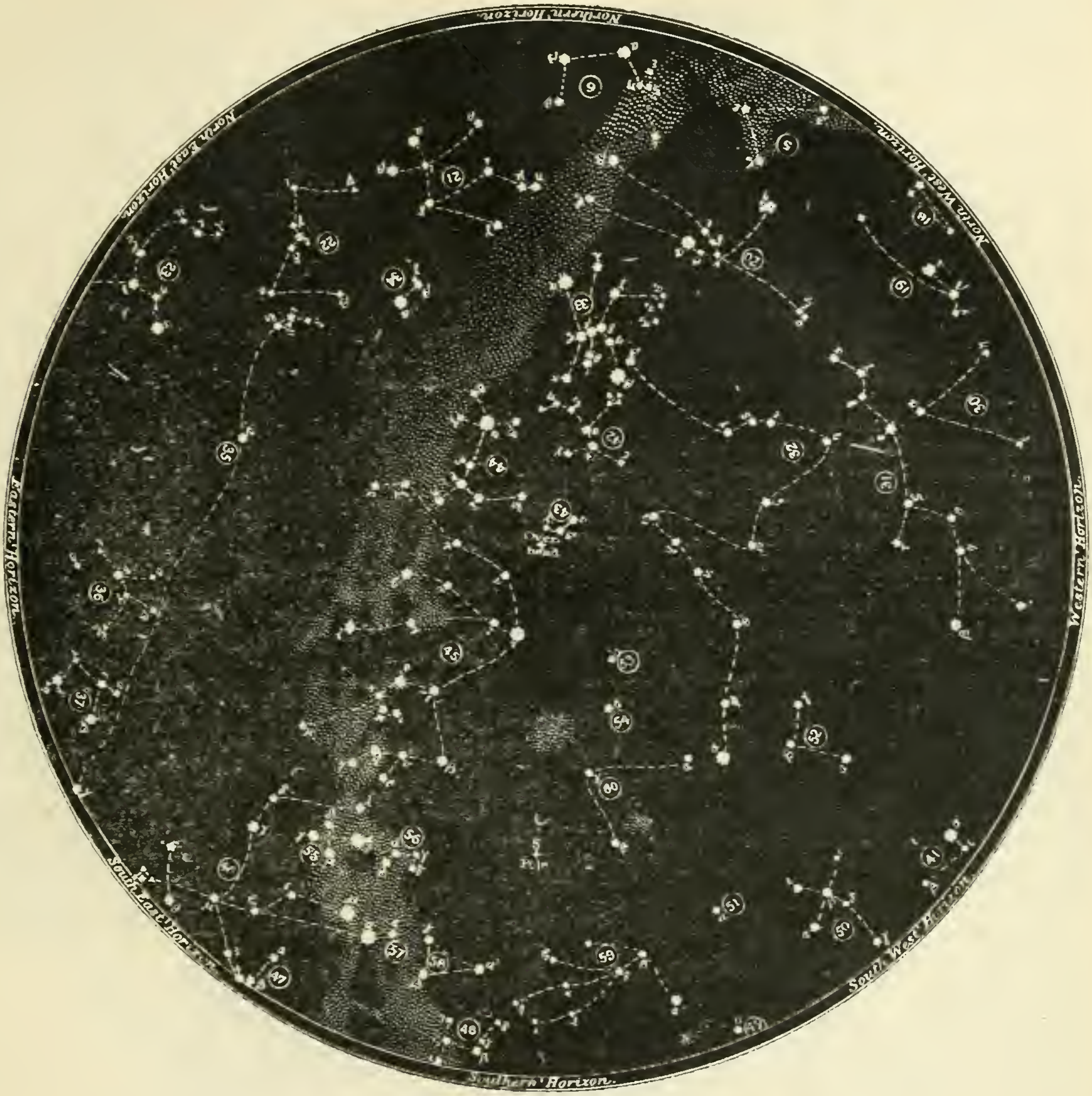
THE NIGHT SKIES IN AUSTRALASIA, CAPE COLONY, ETC.

By Richard A. Proctor.

I REPEAT this month the map showing the southern skies, in January, for places between south latitude 30° and 45°; but the map is this month much simplified. I add the map for February in the same simple form. The Constellations are numbered as in my "Star Primer" up to 46 (*Centaurus*). The remaining numbers indicate the Constellations nearer the south pole, viz.:—

47. *Lupus*, the Wolf.
48. *Ara*, the Altar.
49. *Indus*, the Indian.
50. *Grus*, the Crane.
51. *Toucan*, the Toucan.
52. *Phœnix*, the Phœnix.
53. *Dorado*, the Sword-Fish.
54. *Reticulum*, the Net.
55. *Crux*, the (Southern) Cross.
57. *Circinus*, the Compass.
58. *Triangulum*, the (Southern) Triangle.
59. *Pavo*, the Peacock.
60. *Hydrus*, the Water Serpent.

The student may find it interesting to compare the alternate maps of my "Star Primer" (where twenty-four maps are given, instead of twelve maps, as in the southern series, and my "Half-hours with the Stars") with those now appearing here, which are on the same plan and scale. He will find that the stars showing low down



2. THE NIGHT SKIES IN AUSTRALASIA:—

At 9 o'clock February 6; at 8.30 o'clock February 14: and at 8 o'clock February 21.

towards the south in northern skies at any given hour, are almost exactly overhead in the latitude for which the present maps are drawn. (For this, and for the circumstance that the southern stars circle around a polar point precisely as the northern stars do, the southern skies should make their apologies to Mr. Hampden.)

INDIAN MYTHS.

By "Stella Occidens."

SOME of the North American Indian tribes "allowed themselves the alternative of supposing a dream to be either a visit from the soul of the person or object dreamt of, or a sight seen by the rational soul, gone out for an excursion while the sensitive soul remains in the body."* And others believe that the dreamer's soul leaves his body, wandering in quest of things attractive to it. "These things the waking man must endeavour to obtain, lest his soul be troubled and quit the body altogether."†

During sleep the body apparently remains lifeless and dead, although on awaking the Indian, and all men alike, can distinctly remember events which they dreamt of, and which to the ignorant mind appear as realities. "So strong was the North American's faith in dreams, that on one occasion an Indian dreamt he was taken captive. He induced his friends to make a mock attack on him, to bind and treat him as a captive, and actually submitted to a considerable amount of torture in the hope thus to fulfil his dream."‡

As savages are anything but temperate in their habits,

* Tylor's "Prim. Culture," vol. i., p. 443. † *Ibid.*, 440.
‡ "Origin of Civilisation." Sir J. Lubbock, p. 207.

their sleep after one of their great feasts (especially the dog-feast) must be somewhat disturbed by horrible nightmares. On these occasions sorcerers, and all the friends of the man, are called around to account for the dream.*

No doubt this was done with regard to the myth already related, for we see that the chief really believed that he had travelled along the "Path of spirits" (the Milky Way) and had entered the happy hunting-ground of the Indian—viz., the sun. They believe that it is the "land of happy souls, the realm of the blessed, the scene of the joyous hunting-grounds of the hereafter."†

It is interesting to trace the chief's path, and see how it can be explained. The chief at first describes the path (the Milky Way) as leading him through a shady grove (the shades of night). The elevated ridge is the dusky line or bank of clouds above the northern horizon, from which the first rays of the *Aurora borealis* (the old man) are seen. The old man is described as having white hair, eyes of fiery brightness, and around his shoulders a robe of skins. The streams of auroral light, which sometimes assume a wavy appearance, suggest the idea of the old man's hair, the flashing of the aurora corresponds with the brightness of his eyes, and the robe of skins represents the auroral glare.‡ The old man bids the chief rest awhile, and gives him the following directions. "See yonder gulf (the twilight between Night and Day) and the wide-stretching blue plains beyond (the blue Sky). It leads to the land of souls (the Sun). You stand upon its borders (first dawn of light), and my lodge is the gate of entrance. But you cannot take your body along." This corresponds with the belief among the North American Indians that the souls of the departed either assume the form of stars or birds. They know that when any one dreams of going on a long journey, the body remains in the same place, so they imagine it must be their soul that travels. In the same way at death they suppose that the body is really dead, but the soul assumes the appearance of a bird, and, flying upwards, disappears apparently in the sky. For this reason birds are classed among the deities, in some of the tribes, such as the Creeks and the Natchez;" § and, "as the associate of the god of light and air, the Aztecs reverence a bird called *quetzal*, a species of parroquet." Neither the Hurons nor Mandans would kill the dove, for they believe that doves were inhabited by the souls of the departed.‖ By some other tribes, the dove is supposed to be the keeper of the souls of the dead. It is very natural that birds should be considered inhabitants of another world.¶ As they fly upwards they appear to vanish in the sky; they wander about freely; they are always singing, showing the happiness of the blessed spirits, and their plumage (which is especially gorgeous among some of the American birds) is a fit apparel for the inhabitants of the regions of the sun. The fact of a bird flying over water confirms the idea of its being a soul among the Indians, for they know the body of an Indian could not possibly pass over the water without touching it, as birds can.*

But to return to our chief. He followed the directions of Chibiabos, and leaving his bow and arrows and dog behind him, was soon on his way through the land of "Shadows." He is described as "bounding forward as if his feet had suddenly been endowed with the power of wings."† Possibly he, or rather his soul, assumed the form of a bird, especially as we are told that he met many beautiful birds on his way. At last he came to the banks of a lake (the blue sky), and here he found a snow-white canoe (or white cloud), and on this he floated across the lake, meeting his fair bride on the way. The lake was covered with foam (in other words, the sky was covered with stormy-looking clouds), and the turbulent waves threatened to swallow them up each moment. Some boats (white clouds) were swamped and many were drowned (that is, lost in the larger clouds).‡ The canoes in which little children travelled met no waves and passed over in safety (the children floated on small clouds, which being lighter floated higher in the air, and escaped collision with the bank of heavy clouds below).

At last the chieftain and his bride reached the happy hunting-grounds, and here they wandered, free and happy, among beautiful flowers and meadows. However, their joy was soon ended, for the voice of a spirit wafted on the breeze bade the chief return to earth, and the spirit giving a few directions, the soul returned to the sleeping chief. He awoke from his dream, and carefully related all he had seen and heard, to the great edification, no doubt, of the assembled listeners, who possibly believed that their chief had paid a special visit to the home of the Great Spirit, and had really experienced all he related.

Longfellow introduced this myth of the "White Stone Canoe" into his poem, Hiawatha, in Part xv. "Hiawatha's Lamentation." He is lamenting the death of his great friend Chibiabos, who whilst hunting the deer crossed the Big Sea-Water, and was dragged beneath the treacherous ice by the Evil Spirits. By magic he is summoned thence:

"And so mighty was the magic
Of that cry and invocation,
That he heard it, as he lay there,
Underneath the Big Sea-Water;
From the sand he rose and listened,
Heard the music and the singing,
Came, obedient to the summons,
To the doorway of the wigwam;
But to enter they forbade him;
Through a chink a coal they gave him,
Through the door a burning fire-brand;
Ruler in the Land of Spirits,
Ruler o'er the dead they made him,
Telling him a fire to kindle
For all those who died thereafter—
Camp-fires for their night-encampments,
On their solitary journey
To the kingdom of Ponemah—
To the land of the Hereafter.§

* A whole tribe of Australians have been known to decamp because one of them dreamt of a certain kind of owl, which dream the wise men declared to forbode an attack from a certain other tribe.—Tylor's "Primitive Culture," vol. I., p. 121.

† Brinton's "Myths of the New World," p. 261.

‡ The Eskimo of the extreme north imagines he sees the spirits of the dead clothed in ethereal light, amusing themselves in the absence of the sun, when he sees the bright, ever-changing light of the aurora, and calls it the *Dance of the Dead*.—Brinton's "Myths," 263.

§ Smithsonian "Second Report," p. 281.

‖ Brinton's "Myths of the New World," p. 111.

¶ Among the Lithuanian's traditions the Milky Way is supposed to be the path of birds. These birds are supposed to be the souls of the departed, who fly away free and happy along this path to the land beyond.—Tylor, "Prim. Culture," vol. i., p. 159.

* "The Karens stretch threads across the brooks, in the Burmese forests, for the ghosts to pass along."—Tylor, vol. i., p. 442. And they believe that a dream "is a real journey of the sleeper's soul," for which these threads are no doubt provided.

† Schoolcraft, "Hiawatha Legends," p. 225.

‡ This would suggest the idea of punishment in after-life, but this did not form part of the belief of the North American tribes, until lately, owing to the teaching of the missionaries.

§ "The Algonquins believed that there are villages of the deceased in the sun, and the 'Milky Way' is the road that leads there. As the spirits travel along this 'Path of Souls,' to the land beyond the grave, their camp-fires may be seen blazing as brighter stars."—Tylor's "Prim. Culture," vol. i., p. 159.

From the village of his childhood,
From the homes of those who knew him,
Passing silent through the forest,
Like a smoke-wreath wafted sideways,
Slowly vanished Chibiabos !*
Where he passed the branches moved not,
Where he trod the grasses bent not,
And the fallen leaves of last year
Made no sound beneath his footsteps.†
Four whole days he journeyed onward,
Down the pathway of the dead men :
On the dead man's strawberry feasted.
Crossed the melancholy river,
On the swinging log he crossed it,
Came unto the Lake of Silver,
In the Stone Canoe was carried
To the islands of the Blessed."

"Chibiabos crossed the melancholy river." The Guinea negroes believe "that the departed shall be judged by their god at the river of death, to be gently wafted by him to a pleasant land," if they have done well, but if not, "to be plunged into the river by the god, and thus drowned and buried in eternal oblivion."‡ The Hurons believe that a tree-trunk bridges the river of death : here the dead must cross. The dog that guards it attacks some souls, and they fall.§ Most likely this is the "swinging log" referred to in the poem of "Hiawatha." "The Hurons and Iroquois told the earliest missionaries that after death the soul must cross a deep, swift river, on a bridge formed by a single slender tree, most lightly supported, where it had to defend itself against the attacks of a dog. The Athapascans (Chepewyans) also told of a great water, which the soul must cross in a stone canoe ; the Algonquins and Dakotas of a stream bridged by an enormous snake, or a narrow and precipitous rock ; and the Araucanians of Chili tell of a sea in the West, in crossing which the soul was required to pay toll to a malicious old woman. Were it unluckily impecunious. she deprived it of an eye." With the Aztecs this water was called Chicunoapa, the Nine Rivers. It was guarded by a dog and a green dragon, to conciliate which the dead were furnished with slips of paper by way of toll."‖

But, to return to Chibiabos :—

"On that journey, moving slowly,
Many weary spirits saw he,
Panting under heavy burdens,
Laden with war-clubs, bows and arrows,
Robes of fur, and pots and kettles,
And with food that friends had given
For that solitary journey.
'Ah ! why do the living,' said they,
'Lay such heavy burdens on us !
Better were it to go naked,
Better were it to go fasting,
Than to bear such heavy burdens
On our long and weary journey !'"

This refers to the custom of making provision for the dead, and in many cases horses, dogs, and even the widow, are sacrificed to bear him company on his weary journey. In Schiller's burial song of the chieftain, translated by Bulwer, this custom is referred to :—

"Here bring the last gifts : loud and shrill
Wail death-dirge of the brave !
What pleased him most in life, may still
Give pleasure in the grave.
We lay the axe beneath his head,
He swung when strength was strong,
The bear on which his hunger fed ;
And here, new-sharpened, place the knife,
Which severed from the clay,
From which the axe had spoiled the life,
The conquered scalp away.
The paints that deck the head bestow ;
Aye, place them in his hand,
That red the kingly shade may glow
Amid the spirit land !"

On the north-west coast the American Indians, in burying a chieftain, would place the body in a life-like position, dressed and armed, and often as if engaged in some congenial occupation. such as hunting, fishing, &c. In some cases, horses and dogs are buried alive with the dead body of their master. In one case a chieftain desired a favourite war-steed to be buried alive under him. He owned, among many horses, a noble white steed, that was led to the top of the grass-covered hill, and with great pomp and ceremony, in the presence of the whole nation, and several of the fur-traders and the Indian agent, he was placed astride of his horse's back, with his bow in his hand, and his shield and quiver slung, with his pipe and his medicine-bag, with his supply of dried-meat, and his tobacco-pouch replenished to last him through the journey to the beautiful hunting-grounds of the shades of his fathers ; with his flint, its steel, and his tinder to light his pipe by the way ; the scalps he had taken from his enemies' heads could be trophies for nobody else, and were hung to the bridle of his horse. He was in full dress and fully equipped, and on his head waved to the last moment his beautiful head-dress of the war-eagle's plumes. In this plight, and the last funeral honours having been performed by the medicine-man, every warrior of his band painted the palm and fingers of his right hand with vermilion, which was stamped and perfectly impressed on the milk-white sides of the devoted horse. This all done, turfs were brought and placed around the feet and legs of the horse, and gradually laid up to its sides, and at last over the head and back of the unsuspecting animal, and last of all over the head and even the eagle plumes of the valiant rider, where all together have smouldered and remained undisturbed to the present day.*

* "It was the custom among the Algonquins and other tribes to burn the dead bodies after death. It was, however, a great distinction among the Algonquins. as only those of the distinguished totem of the Great Hare were entitled to this peculiar honour. They gave as a reason, that members belonging to so illustrious a clan as that of Michabo, the Hare, should not be put under the ground as common folks, but rise to the heavens on flame and smoke."—Brinton, p. 162.

† He had left his body behind him, and only his shadow travelled to the sun—or, rather his body had been burned, so only his shadow was left.

‡ Tylor. "Prim. Culture," vol. ii., p. 23.

§ Tylor. *Ibid.* p. 94.

‖ Brinton's "Myths of the New World," p. 266. "It was the custom of the Vikings to be buried in a boat, so that they might cross the waters of Ginungo-gap to the inviting strands of Godheim." P. 265.

* "Bureau of Ethnology," Smithsonian Institute, p. 139, for year 1880-1881

ORIGIN OF COMETS AND METEORS.

By Richard A. Proctor.

ON Nov. 27, 1872, the meteors following after Biela's comet were seen in tens of thousands, as predicted. A few were seen in 1879, on Nov. 28. And on Friday, Nov. 27 last, the display of Bielan meteors announced by me in the *Times* as likely to occur took place as expected, and was witnessed all over Europe. No doubt can remain, I think, in any reasoning mind that the connection of these meteors with the comet named after Biela (which should properly be called Gambart's comet, as Gambart first determined its path) has been amply established. We

have, apart from the evidence already decisive, obtained by Olmsted, Schiaparelli, and Adams, the following points:—A comet appears, whole, in 1826; returns, still whole, in 1832; returns, but is not seen, being unfavourably situated, in 1839; returns, still whole, in 1845; but early in 1846 divides into two; returns, still double, in 1852; may or may not have returned as a double, or perhaps multiple, comet in 1859, but would have been invisible, being unfavourably near the sun on the skies; was not seen in 1866 in any form, or as a comet in 1872, 1879, or 1885; but in each of these three last-named years, when the earth passed through the comet's track, evidence was given by the appearance of falling stars that along that track meteors were travelling, in flights of many millions, far behind the parent comet. It is not merely the agreement as to the year and the day of the year, which enables us to associate the meteors with Biela's comet; they were travelling in that direction, and in that direction alone, out of millions of possible directions, which corresponded with the motion of meteors travelling along the track of the comet. We have to add to this that evidence already regarded as overwhelmingly convincing had shown other comets to be similarly followed by meteoric trains; that, in fact, so far as can be judged, it is in the nature of all comets to have such trains; and that all meteor-streams are thus associated with comets (either whole or long since dissipated). No doubt, then, as to the connection between the Andromedes of Nov. 27 and 28 and Biela's comet can be reasonably entertained.

The occasion seems a good one for touching on the remarkable nature of the problem which meteors and comets, thus understood, present. The facts collected together are so significant that we might fairly expect them to suggest the true theory of comets and meteors as clearly as—to take an appropriate illustration—the meteors seen during some great display indicate by their intersecting paths the "radiant point" of the system. If we examine carefully what has been proved, and sift carefully the theories which have seemed to be established, accepting such parts of theories as really have been established and suspending judgment as to what still remains doubtful, we shall find a singularly suggestive body of evidence in favour of a general theory which, viewed apart from such collected evidence, would appear surprising—nay, even startling—in character.

We require at starting only the following two assumptions—which may be regarded as altogether reasonable:—First, that what has been proved about comets generally may be regarded as true about meteor-systems; and, secondly, that what has been proved about meteors may be regarded as throwing light upon the nature of comets.

Now, it has been shown by the researches of Stanislas Meunier, Tschermak, and others that among the meteorites which reach our earth are bodies, ranging in structure from the asiderites (with very little iron) to the holosiderites (almost wholly iron), which are practically identical with volcanic products, ranging from the ultrabasic to the iron masses found at Ovifak, in Greenland—these last being so like the holosiderite meteors that they were long regarded as indubitably meteoric. It has further been shown that, on a careful investigation of all the evidence in regard to these meteorites and a discussion of the probabilities of their encounter with the earth on various theories as to their origin, it becomes almost a certainty that most of them not only are, as their structure shows, of volcanic origin, but were ejected originally from volcanoes on this very earth on which we live. Mr. Ball, Astronomer Royal for Ireland, has discussed the evidence on this point very soundly, though, as will be seen, he does not carry the reasoning quite as far as it may be fairly taken. Every mass, small or great, ejected from the earth by volcanic action with a velocity exceeding seven miles per second would pass away on a path thenceforth carrying it round the sun, but crossing the earth's track at or near the point where the ejection took place. But for perturbations, the crossing-place would be always at that very point; but perturbations would shift the place of crossing. Thus every meteoric mass so ejected would be exposed to the risk of recapture by the parent earth. On the contrary, the chance that a body ejected from any other planet whatsoever would fall on the earth would be almost infinitesimally small. Thus, while a comparatively small amount of terrestrial ejections would serve to account for the considerable number of meteorites captured within historic times by the earth, we should have to imagine an almost infinitely large number of ejections from any other planet to account for so many captured meteorites (since for each one captured by the earth millions of millions must have been ejected by that other planet if all of them came from it).

So far we are on tolerably sure ground. Yet already we have deduced a very surprising result. Nothing in the present activity of volcanoes would suggest an eruptive power capable of ejecting matter with a velocity of seven miles per second, or more. Yet, remembering the evidence we have that the earth was once in a *quasi*-sunlike state, we can well believe that in her sunlike youth she may from time to time have so concentrated her volcanic energies as to expel matter even with the tremendous velocities indicated by Ball's, or rather Tschermak's theory. Possibly, turning presently to a body which actually is in a sunlike state, we may find evidence showing that this is the way with sunlike orbs.

Here Tschermak and Ball pause. Content with showing that probably many millions of meteoric bodies were ejected from our own planet when she was a small sun, they overlook the inference that what she could do the other planets could presumably do also. Mr. Ball, indeed, while admitting the possibility of this in the case of planets no larger than the earth, expresses the opinion that the giant planets could not expel volcanic products with the much greater velocities necessary to overcome their own much greater attractions. He overlooks, apparently, the circumstance that if much greater power would be required much greater power existed. The volcanic energies of a planet result from the planet's internal heat, and the internal heat is now recognised as a direct product of the planet's gravity. It would seem highly probable, then, if not certain, on *à priori* grounds alone, that the giant planets would be able, like the earth, to expel millions of millions of meteoric flights from their interior during their sunlike youth—possibly not yet altogether past.

Turning next to direct evidence, we find that among the multitudinous comets belonging to our solar system can be recognised certain families dependent on the giant planets in a somewhat peculiar manner. Long before the significance of the feature had been noticed, I wrote of "The Comet-families of the Giant Planets" as a phenomenon needing to be inquired into. The comets thus classed into families travel around the sun as their ruling centre, but with paths passing near severally to the track of one or other of the giant planets—Jupiter,

Saturn, Uranus, or Neptune. Near, too, as the approach is now, we may reasonably assume that this nearness of approach indicates actual intersection at some remote time in the past. The resemblance between this peculiarity, and the intersection of earth-ejected meteor-streams with the earth's orbit, according to the theory of Tschermak and the Astronomer Royal for Ireland, need hardly be insisted on. If, as they consider almost certain, the meteor clouds vomited forth by the earth in long-past ages became meteor streams travelling round the sun, but always passing near the earth's orbit, then the more important meteor clouds expelled by the giant planets would become more important meteor systems travelling round the sun, but ever thereafter passing near the track of the planets from which they had severally been expelled. And, in one case as in the other, the meteor stream would imply a comet, for we have every reason to infer, from what we know about meteors and comets, that every meteor system is probably associated with a comet. Indeed, two of the meteor systems actually identified as attendants on comets, follow severally in the tracks of comets belonging to the families of the giant planets —the meteors of November 14 following in the track of Tempel's comet which passes very near the orbit of Uranus, and the meteors of November 27 following the track of Biela's comet which passes very near the orbit of Jupiter.

I am fully aware that another explanation—only one other seems even possible—has been suggested for the strange way in which comets and meteor systems cling around the orbits of the planets. This other explanation has even been sometimes described — though quite erroneously—as the accepted theory. It was advanced by Schiaparelli as an adjunct of the theory—which really has been accepted, because demonstrated—that meteors and comets are associated. He suggested that the meteor systems which now pass near the paths of the giant planets may have been drawn into the solar system by the perturbing action of those planets near which, on their parabolic course around the sun, they chanced to pass. But while this explanation gives no account whatever of the structure of meteoric bodies, it even fails to account for meteoric streams as we know them. It has been shown (with mathematical demonstration) that no flight of meteors could ever, by the attractions of a giant planet, be so perturbed that all its members would thenceforth travel on practically the same orbit round the sun. Those passing nearest to the disturbing planet would inevitably be sent off on a different path from those which were in the middle of the approaching flight, and these on a different path from those farthest away, unless the flight were very small indeed, in which case its members would be kept together by their mutual attractions and no meteoric stream would be produced.

On the other hand, the theory I have advanced, while itself suggested, and almost demonstrated, by *à priori* evidence, explains perfectly the structure of meteors, and accounts for the eventual conversion of a flight of meteors (vomited forth in the form of a meteoric cloud in some immense eruption) into a meteoric stream.

But we cannot stop here. There is a test which this theory, if sound, ought assuredly to bear. There are orbs actually in the sunlike stage—to wit the stars, and our own star (the sun) in particular. These ought to be actually doing what we have found such strong reason for believing that our earth did in the remote past, and the giant planets (still in the youth of their much longer lives) did, not so very long ago. They ought to be ejecting occasionally vast flights of meteoric masses from their interiors. Our sun, no doubt—to take him as an example—would have to eject such masses with far greater energy than the earth must have employed during her sunlike youth, to send them beyond his own control. For whereas seven miles per second would have sufficed in the earth's case, 382 miles per second would have been required in the sun's. But then the sun is 327,000 times as massive, and therefore as mighty, as the earth, and no doubt volcanic ejections resulting from that vast strength would, in adequate degree, surpass all that our earth could have done, even in the fulness of her youthful energy.

We turn our telescopes, then, on the sun to see whether he ever does such amazing expulsive work as this requires of him, perhaps hardly expecting to find signs of it. But lo! he has been detected in the very act. He has been caught ejecting flights of bodies from his interior with velocities so great that not even his mighty attractive power could ever bring them back again. In one such outburst velocities of 450 miles per second at his visible surface were indicated, which would be 68 miles per second more than would be required to take such matter for ever away from him. This evidence would in reality suffice if it stood alone to account for all the meteoric phenomena we have been dealing with. If he does this now he must have done the like during all the millions of years of his past existence as recorded on the tablets of the earth's crust. If our sun does this, so must his fellow suns, the stars, and they also during millions of past years. Billions of billions of billions of sun-expelled bodies must therefore be travelling in multitudinous courses through interstellar space. And from this we can reason back to the very theory of planetary and terrestrial ejection of meteors to which we had been already led, and from which we had reasoned on to solar ejections.

This theory of the volcanic origin of meteors, and therefore of comets—for without comets there are probably no meteors, and without meteors no comets—is singularly confirmed by the microscopic and chemical examination of meteorites. For Mr. Sorby long since (1864) announced that the microscopic structure of some meteorites revealed their past existence in the form of clouds of globules of molten metal, a state in which, as he said, they could not have ever existed except in the interior of a body like our sun; while in 1867, Professor Graham, exhausting the air around the Lenarto meteor, heated to redness, found hydrogen coming forth in such quantities as to show that that meteorite had "brought to us across the interstellar depths the hydrogen of some fixed star"—which could have happened no otherwise than through expulsion.

Meteorites, meteor-streams, and comets would appear, then, to be products of expulsion from suns, from giant planets, and from orbs like our earth when in the sunlike state.—*Times.*

BAD TIMES.*

THE interpretation given by Mr. Wallace to the prevailing depression of trade is too near the truth to be so popular as any of the various opposing theories over which party politicians have contended. He goes to the root of the matter: it is a far more popular plan to strike at symptoms.

* "Bad Times: an essay on the present depression of trade, tracing it to its sources in enormous foreign loans, excessive war expendi-

He discloses the rottenness of what the multitude regard with fond admiration, the folly of what they regard as the essence of worldly wisdom, the essential weakness of what they regard as symbolical of might. We doubt if his book will be popular; but we are certain that it ought to be, if the many knew their own interests. We can understand that as an essay written in competition for the prize of one hundred pounds offered by the great advertising soap company, this essay (which in one chapter insists on the inherent vice of certain modern trading methods) would have no chance of success. But we are certain that nothing yet said about the depression of trade by politicians has been better worth close and careful study than what has been here advanced by an eminent naturalist,—the secret of whose success in dealing with his subject has been that he has applied to it the strictly scientific method.

Mr. Wallace rejects the popular explanations of the depression, without denying the influence which over-production, Protection as against British trade, Protection as injuring other countries, bad harvests, disturbances of the currency, and other such causes may have exerted. He urges the just objection that the influence of these causes does not synchronise with the progress of the depression which they have been called on to explain. They existed before it began, or started after it was already in progress. This objection is justified by the methods of scientific reasoning. The depression has been too definite in character, too marked in its rise, culmination, and in at least the beginning of its diminution, not to suggest that the cause or causes, whatever they may have been, must have originated and progressed *pari passu* with the effects.

Some at least of the causes suggested by Mr. Wallace have probably been much more potent in their influence than those commonly alleged.

In the first place he calls attention to the mischievous effects of great loans to foreign nations, and in particular to the more rotten sort of despotisms. During the years 1870-75 there was a mania for foreign Government loans, which England advanced to the tune of 260 millions, besides large sums advanced for foreign railways and other undertakings. In so far as such loans were directed to advance commercial projects their influence could not be bad. But the greater part of the Government loans, and no inconsiderable portion of the rest, went to strengthen the influence of despotisms and to supply means for the lavish expenditure of persons who care little how they squander money for which others will have to pay. For a time, doubtless, there was a sudden inflation of trade, though it required but a careful study of details to see that the growth of trade "by leaps and bounds," as Mr. Gladstone expressed it, implied no trustworthy progress. Shortly came the inevitable reaction. The money advanced had been in the main squandered. The interest—heavy or the advance would not have been obtained—had to be met by grinding taxes. The bulk of the foreign populations, on which we really rely for our foreign trade—the business supplied by the ruling bodies being by no means permanent—have been unable, owing to the pressure put upon them by the despotisms under which they groan, to be such good customers as they had been before.

Associating with the effect of foreign loans the influence of increased war expenditure, which we may justly do when we consider in how large degree the loans have been raised to meet or to anticipate military expenses, we have only to consider the increasing annual expenses of the principal European countries, to see how seriously the moneys raised by loans are in the first place needed, and in the second place squandered,—for all abnormal increase of expenditure may safely be regarded as implying corresponding waste:—

Our own annual expenditure increased between 1870 and 1884, from 75 to 87 millions, or 16 per cent. This, being less than the increase of our population in the time may be regarded as reasonable, the real trouble with us being not the rate of increase during the last fifteen years, but the already high revenue raised before that time for purposes not wholly beneficial to the nation at large. So far as our revenue has been concerned—and fortunately with us revenue and expenditure correspond pretty closely—we may be content; the results observed are not unworthy of a free nation and a civilised community. But turn now to foreign continental nations, and we find results which cannot but be considered as discreditable to the rulers of the nations concerned as they have been mischievous to the subject peoples directly, and indirectly to ourselves. The annual expenditure of Austria has increased from £55,000,000 to £94,000,000, or 71 per cent.; that of France from £85,000,000 to £142,500,000, or 68 per cent.; that of Germany from £54,000,000 to £112,500,000, or 108 per cent.; that of Italy from £40,000,000 to £61,500,000, or 54 per cent.; and that of Russia from £66,000,000 to £114,500,000, or 74 per cent. The increase of the expenditure of the five chief continental powers has been from £270,000,000 to £525,000,000, or no less than £255,000,000 per annum, or considerably more than £1 per head of the population The State taxation has nearly doubled, and local taxation has in many cases increased in yet greater degree. Can we wonder if the populations of those countries are less profitable customers than they formerly were?

There is this further mischief, that by having so much British money invested in these foreign loans, applied partly in ways altogether alien to our own ideas of what is right and just, it becomes our interest to support the Governments of those countries as against their peoples, from whom alone the interest of our loans can be raised. When this consideration is extended to certain Governments which are not partly but wholly and absolutely iniquitous, we recognise still more disastrous effects from our undue readiness to advance money to every foreign nation ready to offer a sufficiently high rate of interest,—or in other words ready to afford sufficiently obvious evidence of unworthiness.

Military expenditures in themselves present a most painful subject for study: but it seems idle in the present condition of the human race, even in communities regarding themselves as cultured, to dwell on the melancholy spectacle of the energies devoted by races claiming to be not only civilised but religious, on the business of destruction. Viewed from outside, as by an inhabitant of another planet, many of the leading nations of the earth seem to regard the human race as most nobly employed in striving to destroy itself off the face of the earth. That the rapid growth of armies and armaments on the continent of Europe, since the wars by which Germany has of late acquired an unenviable reputation for able savagery, has had much to do with recent commercial depression, no one can deny who considers the utterly unfruitful character of even the work of production as applied to warlike preparations.

---

ture, the increase of speculation and of millionaires, and the depopulation of the rural districts, with suggested remedies." By Alfred Russell Wallace. (Macmillan & Co., London.)

Rural depopulation which Mr. Wallace regards as a cause, seems to us to be more appropriately viewed as an effect of commercial depression. It acts doubtless, as all effects act, in turn, as a cause. But it began with the falling off in trade, of which it was a direct effect. How it operates, however, let it have been brought about as it will, may be seen when we note that the importation of bacon and pork rose from 863,000 cwt. in 1870 to 5,007,000 cwt. in 1883; potatoes from 127,000 cwt. to 4,034,000 cwt., and eggs from 430 millions to 814 millions. Unfortunately such results as these, rightly apprehended, tend to show how long-lasting must be the effects of such depression as has affected our trade during the last ten years. The rural population, driven into the cities by want, will not be restored to rural districts when commerce begins to revive.

In regard to agricultural depression and its causes, Mr. Wallace is in favour of small holdings free from risk of change. He holds with Mr. Barclay that with continuity of occupation and fair rents fixed for long periods and never to be raised on account of improvements effected by the occupier, our land is capable of well repaying the expenditure of labour and capital in its cultivation. The trouble is, that if rents are to be fixed for long periods, the determination of the amount becomes a matter of speculation: and there must inevitably be serious loss either to the tenant or to the landlord in a great number of cases. This may be a less serious mischief than the trouble arising from the unwillingness of the tenant to introduce improvements for which he will eventually have to pay an increased rent, or from the readiness of too many landlords to take to themselves the profits which the tenant is justly entitled to obtain from his own improvements. The whole subject is full of difficulties; and unfortunately the method which seems suggested as the only fair way of meeting the chief difficulty, *i.e.*, enabling all who will to become purchasers of land in perpetuity, at reasonable rates, savours too much of communism to commend itself to general approval. Legislative enactments have proved too often delusive, if not injurious, to be regarded as hopeful means for improving the state of affairs. But the mischief is serious and pressing. So long as a few wealthy landholders have absolute command over a large proportion of the land available for agricultural purposes, with rentals so large as to be free (if they prefer it) to convert crop lands to grass lands, or even grass lands to waste, there will be an ever-growing feeling that there is wrong done to the many. It is manifestly no longer a sound answer to say that because it is the interest of every great landowner to make the best use of his land, room will always be found for a rural population. This is no more true than the argument that slavery is on the whole beneficial because it is the interest of the owners to treat their slaves well. A man who might obtain £200,000 a year from agricultural tenantry on the larger portion of his land, may prefer to sacrifice half this amount in order to have the best portion of his estates free from all signs of agricultural labour. He may regard the money so lost as money devoted to his own special gratification, and the satisfaction accruing to himself as worth the sacrifice. Many certainly do so view the question; and though when this purely selfish way of considering the matter is pushed to an extreme point, as by a wealthy American *parvenu* now dishonouring the old country (and his own) by his presence among us, the community is disgusted, it may be feared that the less obviously displeasing examples afforded by many of our own large landholders are not viewed with the disapproval they merit.

Mr. Wallace considers the existence of millionaires in increasing numbers as among the causes of the general depression of trade. We have here a cause corresponding in some degree in character to the last. The man who has made an immense property by trade (for millionaires of this class are chiefly to be considered, as the only body greatly increasing at present) has free power to use his property as he will, to let it lie idle if he so pleases, to use it in trade with power to wait always for the most profitable markets and to take fullest advantage of the necessities of the many with whom he has to deal, and in other ways to affect mischievously the general progress of trade, either at his own cost (which he can easily afford) or at the expense of others. It cannot be doubted that many millionaires in this country, and still more in America, do thus check the diffusion of wealth; while further by the amount of money devoted to pleasures or luxuries they diminish, directly and indirectly, the amount available for the consumption of the necessaries and comforts of life, and thus seriously help to bring about and extend the depression of trade.

Mr. Wallace dwells justly on the mischievous increase of speculation and finance. It would be difficult to say of how many millions the middle and lower classes of the community in this and other countries are annually robbed, through the temptations held out by the financiers of bubble companies. The effects of the "Limited Liability Act" intended to save those classes from ruin through speculative investments, illustrate admirably Mr. Spencer's argument against legislative interference; for so far from diminishing the evils it was intended to prevent, the Act has intensified them a hundredfold. And if the Act be now repealed hundreds of innocent persons, as well as promoters, directors, and other agents for swindling companies, will suffer from the change. There can be no doubt, however, that mischievous though some of the effects of the repeal of this unwise Act would probably be, they are not to be compared with the mischievous effects resulting from the maintenance of the law unchanged. Hundreds of thousands have been ruined by this piece of so-called protective legislation.

That lastly trade has suffered seriously from adulteration and dishonesty no one can doubt, though this particular cause is by no means new. Builders and contractors were many of them rascals in Norman days, as our old cathedrals testify; and we cannot wonder if among the representatives of British trade to-day are many dishonest men. The adulterator asserts that there is a demand for his villanous merchandise; but possibly if he were obliged to describe his commodities as they actually are, he might not find a very great demand for them. Goods marked "Calico, 90 per cent. China-clay, lime, and size"; "dyed calicoes, warranted not to stand one washing"; "wool, four-fifths shoddy"; "silks, 50 per cent. dye stuff"; "cutlery, warranted not to cut," and so forth,—would possibly not have the satisfactory sale obtained when, as now, the same goods are called "superfine," "all wool," "best Sheffield steel," and so forth.

That in other countries, and especially in America, protection has had much to do with trade depression is no doubt true; but we have enough within our own control to which we may attribute the badness of the times without looking outside, or endeavouring to set matters right by injuring ourselves further through retaliatory tariffs.

GEOLOGY IN LONDON.

By W. Jerome Harrison, F.G.S.

[Before writing the Geology *of* London, I think it will be well to say a few words about Geology *in* London, explaining the facilities which the metropolis affords for acquiring, or adding to, a knowledge of that science.]

MANY a dweller in London has, to my knowledge, scorned the idea that he, or she, was favourably situated for acquiring a knowledge of geology. "What can I do among the bricks and mortar!" they exclaim; and they envy the lot of those who live in wild Wales or stony Scotland, where the opportunities for studying the rocks are, they think, so very superior.

But it is of no use to be surrounded by quarries and cliffs unless the power of understanding the phenomena they exhibit has been, or can be, acquired. Teachers must be at hand, and museums must be accessible, if the way of the tyro is to be made smooth. As a place for learning geology I know of no district to equal London. As a home for the advanced student of the science London is equally desirable, with its grand collections of books and specimens, and the opportunities afforded by its scientific societies for the meeting of kindred spirits. Many a man of science has made great sacrifices in order to be able to dwell in London, and avail himself of these advantages.

Let us see, first, what public collections of geological specimens exist in London.

THE MUSEUM OF PRACTICAL GEOLOGY, JERMYN STREET.

The most central is the Geological Museum in Jermyn-street. We owe this fine building to the energy of the late Sir Henry de la Beche, the first Director of the Geological Survey. The museum was opened by Prince Albert in 1851. It is free to the public on Mondays and Saturdays, from ten to ten; and on other days (Friday excepted), from ten a.m. to four or five p.m. The building is illuminated, on the two evenings on which it is open weekly, by the electric light.

The present Curator, Mr. F. W. Rudler, is not only among the most able, but is one of the most courteous of museum-keepers; his kindness and patience are as inexhaustible as his knowledge, as I—with many others who have "wanted to know"—can gratefully testify.

Adjoining this museum is the headquarters of our national Geological Survey. Its officers are ever examining the strata in some part or other of England, and all the specimens of rocks, fossils, and minerals which they collect are sent up to Jermyn-street, there to be named and catalogued; while the choicest specimens are placed in the museum cases. In this way, aided by purchases and by numerous bequests—one of which alone, the Ledlam collection of minerals, is of the estimated value of £15,000—the Jermyn-street Museum has acquired a magnificent and very extensive series of specimens illustrating mainly British geology. In the well-written "Descriptive Guide" of nearly two hundred pages (price sixpence) a full account of the contents of the building is given. In the entrance hall the building and ornamental stones of the United Kingdom are exhibited; upstairs, on the principal floor, is the grand collection of minerals, which are worth viewing, if only for their beautiful forms and colours. Here, too, are some memorials of Sir Roderick Murchison, the splendid vase of avanturine, and other objects presented to him by Nicholas, Emperor of Russia. Close to this vase is a geological model of London, embracing about 165 square miles, and offering, as far as may be, a really "royal road" to the understanding of the arrangement of the strata in and around the metropolis. This model not only shows the rocks which are at the surface, but its sides reveal the strata to a depth of 1,000 feet. It is in nine sections, any one of which can be raised for separate examination. The light iron galleries which surround the hall rise tier above tier, and the cases which they contain include many thousands of specimens of rocks and fossils, each carefully labelled and arranged in stratigraphical order; *i.e.*, the fossils from the oldest rocks come first, and are placed as one group; and so on, up to those which we know to be of comparatively recent date. Here the student may bring his "find," and it must be rare indeed if it cannot be matched, so that he is enabled to learn its name and nature. Besides the geological collections, the Jermyn-street Museum contains a large and valuable collection of British pottery, porcelain, and glass. There is a fine library, accessible to all who state the object with which they wish to consult the books; and a lecture-theatre in which science-lectures are delivered during the winter to crowded audiences of working-men. Besides the General Guide already named, there are six printed catalogues, describing very fully the various collections. The Jermyn-street Geological Museum is certainly an institution which no one can visit without obtaining both profit and pleasure.

THE NATURAL HISTORY MUSEUM, SOUTH KENSINGTON.

The great and continually increasing pressure on the rooms of the British Museum in Great Russell-street, long ago determined the trustees to find accommodation elsewhere for the natural history collections, and in 1881 they were transferred to the magnificent terra-cotta building erected from the designs of Mr. Waterhouse, in Cromwell-road, South Kensington. The guide-books which have been written to the various galleries here are so admirable, and withal so cheap, that we strongly recommend every student to send for them, whether they ever intend to visit the Museum or not. They include a guide to the galleries of Geology and Palæontology (3d.), the Mineral gallery (3d.), Meteorites (1d.), Fossil Fishes (3d.), and index to the collection of Minerals (2d.). The principal workers by whom the collections have been arranged and the guide-books written, are Dr. H. Woodward, and Messrs. L. Fletcher, R. Etheridge, T. Davies, and W. Davies. Dr. W. Flight, whose knowledge of meteorites was simply encyclopædic, has died quite recently. The specimens here are great in number, and probably unequalled in the world for rarity, size, and beauty. The fossils are arranged zoologically, all the members of each genus, order, family, &c., being placed together; a plan which forms the complement to that adopted at Jermyn-street, where, as we have seen, the fossils are classed stratigraphically. The collection of meteorites includes "air-stones" which have fallen in all parts of the world, some being of great size and weight.

This museum is open every weekday from 10 a.m. to 4, 5, or 6 p.m., according to the season of the year; and on Mondays and Saturdays till 8 p.m. in summer, and 7 p.m. in winter.

THE MUSEUM OF THE GEOLOGICAL SOCIETY.

In the rooms of the Geological Society, at Burlington-house, Piccadilly, there is an extensive geological collection, intended especially to represent and illustrate the papers on geological subjects which are read to the

Society. With an introduction from a Fellow, the specimens can be examined between ten and five daily. The library of geological books, of which an excellent catalogue has been printed, includes about 30,000 volumes.

LONDON DEALERS IN GEOLOGICAL SPECIMENS.

Prof. Tennant, whose shop in the Strand, near King's College, was so well-known a resort, has gone from among us, but Mr. Henson, at 277, Strand, may be considered to have supplied his place. Mr. Henson's specialty is rare and valuable minerals. To Mr. R. Gregory, of 88, Charlotte-street, Fitzroy-square, I have been indebted any time this twenty years, not only for excellent and cheap specimens, but for the freedom with which he has permitted me to draw upon the remarkable practical knowledge of rocks, minerals, and fossils of which he is possessed. Then there is Mr. Bryce-Wright, of 90, Great Russell-street, and Mr. Russell, 78, Newgate-street. Any or all of these dealers can be relied on to furnish typical and correctly-named specimens of rocks, fossils, or minerals at a moderate price—from sixpence to one shilling each for the commoner varieties.

The Migration of Abram.—A paper on "Historical Evidences of the Migration of Abram" was read on Monday night by Mr. W. St. Chad Boscawen at a meeting of the Victoria Philosophical Institute, in the hall of the Society of Arts, London. Mr. Boscawen reminded his hearers that only of late had the grave-mounds of Chaldea yielded the monuments and inscriptions which the decipherer had revivified by his almost magic skill, forcing them to become witnesses in the cause of truth (hear, hear). This series of historic records extended over twenty-five centuries in almost unbroken sequence before the Christian era. Having minutely examined the testimony of the monuments with reference to the Hebrew account of the migration of Abram, Mr. Boscawen said there were inscriptions to prove the existence of a Semitic population in the city of Ur of the Chaldees as early as 3750 B.C.—a people who spoke a language closely akin to Hebrew, and bore names similar to those of the early Hebrew patriarchs. In religion, though not monotheists, they certainly had a purer creed than that of their Turanian-Akadian fellow-countrymen; and at the head of their pantheon was the supreme god Ilu or El, whose name, like that of El and Jehovah, entered into the composition of many personal names. In the year 2280 B.C. Chaldea was invaded by the Elamites, who established a dynasty of their kings. The fall of this dynasty, caused by the defeat of Kudur-Mabug and Eriaku or Arioch by Khammurabi in 2120 B.C., seemed to synchronise very well with the defeat of Chedorlaomer, recorded in Genesis xiv. The migration of Abram must therefore fall within this period of 160 years. The monuments showed that at this time such an alliance of Mesopotamian kings as that recorded in Genesis xiv. was most probable. The invasion of Chaldea by the Elamites and the conquest of Syria by those kings synchronised well with the date of the Hyksos invasion of Egypt—the date when Abram would have entered Egypt under the most favourable circumstances. The invasion of Chaldea and the conquest of Ur, Erech, and Babylon by Elamites would press more severely on the Semitic than on the non-Semitic population, forcing them to migrate northward. The close religious affinity between the worship of the temple at Ur and that at Harran would render the migration of this people from one city to the other most probable. All these points taken together tended to show that the record of the migration of Abram in Genesis agreed perfectly with the Chaldean and Western-Asiatic history revealed by the monuments (cheers). The chairman stated that Professor Sayce, who was in Egypt, had sent a communication criticising Mr. Boscawen's dates, but evidently not disputing his facts. They might therefore congratulate themselves upon his attitude, as everything that proved the reliability of the Bible was most important (hear, hear). Mr. E. A. Budge agreed generally with Mr. Boscawen, that the record in Genesis was proved to be correct. The Rev. Dr. Wright, M. Bertin, and other gentlemen also spoke. Several references were made during the evening to the urgent need of excavations in the great city mounds of Western Asia, especially in ancient Kharran, and to the fact that English discovery had been at a complete standstill for four years, in consequence of our Government being unable to secure the necessary firman from the Porte.

OUR MAMMAL COUSINS.*

THIS work is intended to meet a decided want. It deals primarily with the mammals in their relation to the earliest ages of animal life upon the earth. But while it thus only relates to a limited field, it presents an important general lesson, as well taught thus by a typical example, as it could be by studies ranging over a wider area. This is the truth, constantly overlooked by opponents of the doctrine of biological evolution, and often overlooked by supporters (among whom are many who have little knowledge of the actual nature of the theory they support)—that the various races now present on the face of the earth have certainly not descended along lines of which living examples remain. Again and again we see the mistake made of presenting as the true course of descent for the more advanced races now existing, a sort of traverse line athwart the various less advanced races. It is as though an insect living within the domain formed by a vast tree should trace the history of some particular set of leaves by regarding them as directly related to another set of leaves in a remote part of the tree, instead of tracing the development of each set along the twigs, sprays, branchlets, branches, boughs, &c., to the parent stem,—though indeed this parallel indicates but an infinitesimal part of the complexity of the actual problem.

Professor Oscar Schmidt, whose "Doctrine of Descent and Darwinism" (in the same series as the present work) is well and favourably known, deals in this volume with the Mammals, and shows how vain have been the attempts of naturalists in former times to bridge over the gap separating the mammalia from the other vertebrates of the present day, and that the difficulty is not at all or but little removed by our present knowledge of primæval times. He considers the various isolated forms within the class of mammalia. Thus the horse and its relatives are set by the side of the two-hoofed animals; but the differentiation of the one-toed horse from the two-toed oxen and stags remains completely unexplained, while the dentition of the horse separates it much more strikingly from the ruminants than from other animals which zoologists set much farther from the horse. Again the so called many-hoofed animals present no unity among themselves, the class including genera which differ from one another in structure, feet, and teeth, more than do the members of orders not set far apart by the descriptive biologist.

Geographical differences still further increase the difficulty of arranging the various classes of mammals as they exist at the present time. We find examples in different continents not only of associated races, but of races which are, in fact, one, wherein, nevertheless, differences of detail may be recognised which are as marked as those by which distinct genera are separated within a limited area. Then we have difficulties higher than those of mere classification, when we consider such a problem as, for example, the existence of kindred races of fresh-water fish in rivers between which there is now no connection except by seas, in which, at present, these races cannot live. We cannot possibly trace the descent of a fresh-water fish in European rivers from a fish of the same race in American rivers (or *vice versâ*); yet of their kinship, the scientific as distinguished from the

* "The Mammalia in their Relation to Primæval Times." By Oscar Schmidt. Kegan Paul & Co., London.

merely descriptive zoologist can have no manner of doubt.

On a still more limited field than that with which Prof. Schmidt here deals, Prof. Mivart indicated what he maintained to be a difficulty in regard to the kinship of men and apes. He pointed out that while man is nearer to the Gorilla in some respects than to any other of the anthropoid apes, he is in other respects nearer the Chimpanzee, in others to the Orang, in others to the Gibbon, while in some respects he is nearer to lower orders of Simians or even to the Lemurs. If Darwinism predicated descent along lines which can be traced even now, the objection would have had some force. But the theory of evolution as advanced by Darwin involved no such fallacy, and in reality Mivart's objection had no more weight than would an objection have against the theory of the kinship of the present races of man which should show that in some respects the Caucasian is nearer to the Mongol than to the Ethiopian type, but that in other respects the order of resemblance is reversed. In fact, it might with equal reason be urged that a man is not a blood relation of the members of a family really his third or second cousins, because in some features he is much more like some members of that family than the rest, but in other features he more closely resembles other members of the family.

Professor Schmidt by indicating the features of resemblance and difference found among various families of mammals—as among the two-hoofed animals (the Pigs, Hippopotamus, Ruminants, Camels, Deer, Antelopes, Oxen, and so forth), the one-hoofed animals (Tapirs, Rhinoceros, Horse, &c.), the Elephants, Sirenia (Sea-cows), Whales, Flesh-eaters, Seals, Insect-eaters, and Anthropoids, brings out very clearly the impossibility of all attempts at thwart co-ordination. Clearly that is to say when the evidence is understood, and duly weighed. We cannot say much for the clearness of his style, while occasionally the defects of the English translation go far to render his meaning even more obscure than a certain undue reliance on the analytical powers of his readers has made the original. Of verbal faults, bad English, and so forth, we need say little perhaps: since if, for example, he is made to say at p. 87 that "the absence of teeth in the jaws of the monotrema is distinct from the ancestors of toothed mammals," every reader knows what he means. It is different, however, with such a passage as the following:—

"When comparing the genuine Hoofed Animals with their ancestors, it was seen that the loss of one or two toes took place as early as in the first Tertiary division. It was only single genera that still showed the old five-toed extremity, an inheritance from Pre-Tertiary times. However all the living Sirenia possess a five-fingered hand. When therefore it is said that the molars of Prorastomus [an old tertiary group of Sirenia] are genuine ridged teeth, these do not point to the true Lophiodonta and tapirs, with their already reduced hand, but to earlier ancestors on both sides. Thus things no longer existing point to that very distant past, which extends back beyond our actual observation. Even in the case of Halitherium all that is left of the hind limb is the thigh bone. This bone, however, is still attached to the pelvis, which is tolerably reduced, and has a socket. The earliest Sirenians, therefore, had a less striking form of skull, but nevertheless, in their whole appearance were already like the present living species. From this it follows that the four-footed mammals changed their abode for the sea, and lost their hind limbs, before the Tertiary period."

All this is very clear to the student of zoology who has already clear ideas as to the significance of the various forms of evidence; but we fear that it must be rather hard reading for the general reader, to whom the *sequiturs* appear by no means so obvious as Professor Schmidt seems to think them.

A Positivist View of the Sermon on the Mount.—"The Gospel (I say it in no contemptuous sense) is the religion to-day of *women;* for women, at least for the present, are so much less called to public duties than are men. But does the 'Sermon on the Mount' make good citizens to-day? Did it ever make them? The 'Sermon' of Jesus is full of refined and purifying sentiments; there are counsels too often forgotten, as where it is said—'Whosoever shall say to his brother Raca, or thou fool, shall be in danger'; and—'Let your communication be yea, yea, nay, nay: for whatsoever is more than these, cometh of evil.' That, no doubt, is still useful counsel; but is it the priests of the Gospel whose communication in political strife is ever—yea, yea! and never Raca, or 'thou fool'? And when we go to the other precepts of the 'sermon'—'Resist *not* evil!' 'Resist *not* evil!' 'Turn to the smiter the other cheek also!' 'Give to him that asketh thee.' 'Take no thought for your life.' 'Take no thought for the morrow; for the morrow shall take thought for the things of itself. Sufficient unto the day is the evil thereof.' What teaching is this? Prudence, energy, foresight, practical wisdom, severe justice, worldly sagacity, all the stern virtues of the manly citizen, actually denounced as sin! I do not doubt that there are profound elements of personal purification in this supernatural trance—so there are in the ineffable ecstasies of a Buddhist mystic, or a Mussulman dervish—but how utterly incompatible with politics or any useful conduct in the social world! There may be practical and sensible Christians, and the Gospel may not altogether exclude courage and energy in politics; but it is in spite of the creed, not by the aid of it, by strange perversions and adaptations of its literal sense. The active devoted citizen not only gets no guidance whatever from the 'Sermon on the Mount,' but almost every public act of his life is a violation of its precepts, to be justified only by the argument that its precepts are an impossible form of mystical extravagance. It must always be so where religion rests on any theological basis whatever. Theology, and supra-mundane sanctions, ecstatic bliss, eternal torments, absolute transcendental objects of worship, of themselves exclude all healthy and rational politics. They act with potent, though spasmodic, effect on the individual soul, the sense of sin, the voice of conscience, the desire of purity, and thirst after righteousness. But bring them to public life, and the charm is snapped. The care for our souls, the hope of glory in Heaven, the preposterous hyperboles of all the gospels and the priests, have no common ground with prudent citizenship. Either they lead us off from any interest in these worldly things; or, if they bring us to worldly things at all, it is to present them in theological, clerical, or ecclesiastical lights. What can the welfare of England, or the sympathy of classes, or the reform of taxation, matter to men who teach that in a brief span we shall all be with the Angels or the Devils, forever and forever; to whom the Saviour of mankind has committed the task of cursing those who take a different opinion from theirs."—Mr. Frederic Harrison *on the Religion of Humanity.*

Gossip.

By Richard A. Proctor.

I am a little troubled about the Victoria Institute. I fear that society is not going quite in the way originally intended for it. A paper was recently read before the society which seems open to decided objections, by those who insist upon the literal accuracy of Bible statements. In this paper Mr. St. Chad Boscawen pointed to monumental evidence proving that from as early a period as 3750 B.C. there existed a Semitic population in the city of Ur of the Chaldees, whence the Bible says that Abram's family sprang. "The inscriptions found at the neighbouring city of Larsa, relating to the trade and commerce of its people, showed them to have spoken a language akin to the Hebrew, and to have borne personal names strikingly like those of the Hebrew patriarchs. In religion, though not Monotheists, they certainly had a purer creed than that of their Turanian-Akkadian neighbours, and at the head of their Pantheon was the supreme God Ilu or El, whose name like that of El and Jehovah among the Jews, entered into the composition of many personal names." Mr. Boscawen went on to show that in 2280 B.C. Chaldæa was invaded by the Elamites, and a dynasty of Elamite kings was established, of which Kudur-Mabug and Eriaku, or Arioch, were members, "The fall of this dynasty caused by the defeat of Kudur-Mabug and Eriaku, by Khammurabi in B.C. 2120, would seem to synchronise well," said Mr. Boscawen, "with the defeat of Chedorlaomer recorded in Genesis xiv. The migration of Abram must therefore have fallen within this period of 160 years."

* * *

All this looks at first "very pleasant and conformable." The various points considered in Mr. Boscawen's paper may be considered, as Mr. Boscawen claims, "to show that the record of Abram's migration in the book of Genesis is in perfect agreement with the state of Chaldæan and Western Asiatic history revealed to us by the monuments." With excellent Bishop Peter of Rumtifoo, "I do not say it ain't; but *time* my christian friends!" A Semite population in the year 3750 B.C., and Abraham migrating into Egypt between 2280 and 2120 B.C.! Shem was the only Semite living at the time of the Flood. Now the bible says distinctly that two years after the Flood Arpachsad was born; thirty-five years later Shelah; thirty years later Eber; thirty-four years later Peleg; thirty years later Reu; thirty-two years later Serug; thirty years later Nahor; twenty-nine years later Terah; and seventy years later Abram, Nahor, and Haran. This gives (throwing one year in between each birth) not more than 300 years from the Flood to Abraham's birth (which happened therefore fifty years before Noah died). Now Abraham only lived 175 years, dying therefore not more than 475 years after the Flood (and twenty-seven years before Shem himself). How Mr. Boscawen and the Victoria Institute can reconcile these figures with the existence of a Semitic race 1,530 years before the earliest possible date for Abraham's migration, passes all comprehension. The call of Abraham took place when he was ninety-nine years old, not more than 400 years after the Flood, so that Mr. Boscawen would have us believe in a Semitic race or tribe, and in Semitic cities, 1150 years before the Flood, and 1152 years before the firstborn of Shem, the father of the Semitic race, was born. He cannot mean an antediluvian tribe of Semites, for he speaks of Abraham as belonging to this tribe. The Victoria Institute have got the whole affair mixed up strangely.

* * *

My attention has been directed by several correspondents to a mistake—in reality a clerical error—respecting the Feast of Tabernacles in the article on the "Religion of Science," Knowledge, New Series, No. I., p. 2, col. 2. I seem to speak there of the *Fast* of Tabernacles, saying that "the enforced gloom of the Fast of Tabernacles (when not to fast was to incur death) corresponded with the mourning among Sabaistic nations as the sun neared the season of his second Passover, his transit across the equator from glory to gloom." In reality the first "fast" was a misprint for "feast," and the opening words should have run, "the enforced gloom of the day of atonement near the season of the Feast of Tabernacles." In an article on the "Origin of the Week," in my "Myths and Marvels of Astronomy," the correct relation between the observances of the first month (or month of the ascending passover) and those of the second month (or month of the descending passover) will be found correctly indicated.

* * *

The association between the two passovers, though the second lost the distinctive name which doubtless it had possessed among the Egyptians and Chaldæans, is too obvious to be overlooked. In the tenth day of the first month (following the vernal equinox as near as the moon would allow) every man was to take a lamb, and to keep it up until the fourteenth day of the same month. (The words "keep it up" must not be misunderstood in a festive sense). That day was the Passover interpreted by Moses in a special way (just as he interpreted the Sabbath rest in two special ways) to prevent the people from retaining the original idea, which was doubtless that of the passover of the sun ascending as Lord of the Year. On the fifteenth day began the Feast of Unleavened Bread which lasted for seven days, during which daily sacrifices (besides the burnt sacrifice offered each morning to the rising sun as Lord of the Day) were offered, "food of the offering made by fire, of a sweet savour unto the Lord" according to their strange anthropomorphic ideas of Deity. Now the seventh month bore the same relation to the autumnal equinox, or to the sun's descending passover, which the first month bore to the vernal. We find accordingly that on the tenth day of this seventh month, there was appointed a special day of mourning or affliction, the day of atonement. Just as the sacrifice to the rising sun as Lord of the Day was balanced by an evening sacrifice to the same orb when setting, so the special spring observances in regard to the sun ascending above the equator as Lord of the Year, were balanced by special autumn observances in the regard to the same orb when about to descend below the equator. And naturally the day consecrated to the descending passover of the sun god, though belonging to a season of thanksgiving for the fruits of the year, was made a day of affliction. An offering made by fire was presented to the Lord (to Jehovah by the Jews, but to the Sun God by the originators of the observance). And thus solemnly were the people adjured to afflict themselves (for atonement according to the law of Moses, but because of the dying of the sun's power according to the Chaldæans and earlier Egyptians)—"Ye shall do no manner of work in that same day; for it is a day of atonement, to make atonement for you before the Lord your God. For whatsoever soul it be that shall not be afflicted in that same day, he shall be cut off from his people. And

whatsoever soul it be that doeth any manner of work in that same day, that soul will I destroy from among his people. Ye shall do no manner of work; it is a statute for ever throughout your generations in all your dwellings. It shall be unto you a sabbath of solemn rest, and ye shall afflict your souls; in the ninth day of the month at even, from even unto even, shall ye keep your sabbath." Even until now the whole day of atonement is kept as a day of affliction by the Jews, a fast for twenty-four hours,—even by many Jews who are careless about all the other observances of Judaism. But while this day, marking the descent of the sun to the winter half of his career was a solemn fast and a day of mourning, the day of the Passover was a feast,—"This day shall be unto you for a memorial," said Moses, "and ye shall keep it a feast to the Lord; throughout your generations ye shall keep it a feast by an ordinance for ever."

* * *

It seems to me about as likely that the morning and evening sacrifices did not refer to the rising and setting sun, or the monthly sacrifices to the moon, as that originally the Feast of the Passover and the Fast of the Atonement did not refer to the ascension of the sun above the equator and his descent below it. I expect, however, that the day of the Passover was originally so fixed as to follow by three days (clear) the day of the actual crossing of the equator as determined by the astronomical priests of Egypt and Assyria, while in like manner the day of mourning preceded by three days (clear) the day of crossing the equator descendingly. The days of crossing, then, would be the tenth day of the first month and the fourteenth day of the seventh. We have traces of this in the killing of the Paschal Lamb on the tenth day of the first month, the day of the Passover, the fourteenth being immediately followed by the Feast of Unleavened Bread lasting for seven days beginning with the fifteenth; while the Day of Atonement on the tenth day of the seventh month was also followed by a feast of seven days beginning with the fifteenth day. This arrangement would leave an interval, from the killing of the Paschal Lamb to the beginning of the Feast of Tabernacles, almost exactly equal to the interval from the day of exactly twelve hours in spring to the day of exactly twelve hours in autumn.

* * *

It might be interesting to inquire how much farther the ideas originally connected with sun-worship penetrated into at least the ceremonial of the religions of to-day. It is tolerably well known that the earlier teachings of Christianity were associated with—some even have gone so far as to say that they had their origin in—the teachings of races farther east than Palestine, who at any rate in ceremonial retained the traditions of sun-worship. There is curious evidence on this point in a letter from the Emperor Hadrian to his brother-in-law Servianus, A.D. 134 in which he says, "The worshippers of Serapis" (the Sun-god) "are Christians, and those are consecrated to the god Serapis, who, I find, call themselves bishops of Christ." Of course, he must in some way have been misled by the resemblance between what he had heard about the birth, crucifixion, resurrection, and ascension of Christ, and what he knew about the birth of the Sun-god in Virgo,* his crossing (or Passover), recognised rising three days later (retained in the Jewish interval from the Passover to the beginning of the Feast of Unleavened Bread) and ascension to the glorious part of his—the Sun-god's—annual career. So also when he goes on to say "there is no presbyter of the Christians who is not either an astrologer or a soothsayer," he doubtless misinterpreted those matters of ceremonial observance which the Christians of his day retained from the ceremonial of sun-worship, on the same principle which led the early Jewish legislators to retain much of the same ceremonial, in fact the whole of its sacrificial portion, rather than disturb their people's minds by changes in unimportant matters, while they nevertheless zealously purified their actual teachings from all that they deemed inconsistent with the worship of one only God.

* * *

Mr. Wallace has I conceive done good service in calling attention to certain causes of depression in trade for which we are ourselves in large part responsible, instead of humouring that feeling which has led many to see no fault save in other nations. Of course there are some who will take exception to Mr. Wallace's arguments for no better reason than that being an eminent naturalist he has no right to form or express any opinion at all about trade or commerce. Others again may argue that because he has been deluded about certain spiritualistic matters over which many enthusiasts have gone astray, and about which some of the most learned have entertained strange superstitions, his opinion about national well-being can by no means be worth listening to. For my own part I hold all such objections as futile; and although as readers of Knowledge may have noticed I am by no means a believer in spiritualism (regarding many phenomena associated with it, however, as real, though natural) I can see no reason why either his skill as a naturalist should be regarded as a reason against his forming or expressing an opinion on that subject, nor on the other why because on that misleading and time-wasting subject he has erred he therefore should necessarily form erroneous opinions about trade depression, a matter which falls within the department of observational and indeed of experimental research.

* * *

A valued correspondent,—one of a rather large number who have discussed the question about Force and Energy, touched on in last month's "Gossip," notes that beside the more common misapprehensions into which Huxley, Romanes, Mivart, Hæckel, and others have fallen, being followed by many, there is one mistake which even special teachers of mechanics—as Tait and Balfour Stewart—have fallen into. They describe Kinetic Energy as Active, and Potential Energy as Passive. Now at a first view this seems right. A bullet flying from the mouth of a cannon or a stone flying swiftly through the air seems to tell us of very active energy; gas at high pressure or a compressed spring seems passive. Water at a height, in a reservoir, seems passive, water swiftly moving (upwards, downwards, or horizontally) seems active. But in reality it is the potential energy which is really active, the body which manifests kinetic energy is passive. The circumstance that a moving mass may at any moment communicate motion to some other body, or may even while it is moving be communicating motion, gene-

* In the Buddhist books we find the tradition that the Buddha was born of a virgin interpreted in like manner. In their story it is presented in its seemingly most monstrous form that the Buddha entered the side of the virgin in the form of a white elephant. But so soon as we note that the white elephant was the recognised Buddhist emblem of the sun, we see that the tradition belonged to sun-worship and is to be interpreted astronomically.

rating heat, or in some other way doing work, by no means makes its *motion* active. Such motion as it has, and is for the moment retaining, represents in reality passive energy. On the other hand, energy of position or potential energy is essentially active. The compressed spring is all the time exerting pressure. So is the compressed gas even though it be held compressed. Water in a reservoir is exerting active energy, as the strength which we have to give to the reservoir should show us. Weaken the walls by which the ever-struggling energy downwards is opposed, and that energy will show in a very obvious way whether it is active or passive. It may be argued that only so soon as it is thus free to show it is active can we recognise its activity: but in reality we might as reasonably argue that a prisoner pulling with all his strength at the bars of his prison is inactive, and that he is active only when the bars have yielded and he gets away.

* * *

If one were asked to indicate one hundred of the vainest things men had ever attempted, one might after setting at the beginning the attempt itself, set next the attempt to indicate the hundred books which a man should read. Perhaps the absurdity of this attempt has been emphasised by the way in which persons of very special pursuits, tastes, aptitudes, and so forth, have indicated the hundred books they find best as best for all. Then the way in which the word book has been used in these lists adds to the absurdity. "Read Shakespeare and Cicero De Amicitià!"—one might as well say "Read the Bible and the episode of Glaucus and Diomed in the Iliad," or "read Darwin and Chaucer's 'Nonne Priestes Tale.'"

* * *

I would suggest as a pendent to Sir J. Lubbock's list, the following:—

TWENTY ARTICLES OF CLOTHING "THAT WOULD SUFFICE FOR 'A PERSON'S' WHOLE STOCK."

1. A cocked hat.	11. Set of shirts (frilled and ruffled).
2. Galligaskins.	12. Straps.
3. A Fardingale.	13. Collars.
4. Nankeen coat.	14. Dalmatic.
5. Mark-of-the-beast waistcoat.	15. Braces.
6. Boots.	16. Neckties (various).
7. Button-hole nosegay.	17. Waterproof overcoat.
8. Epaulettes.	18. Berlin gloves.
9. A chasuble.	19. Kid slippers.
10. Trousers.	20. Furbelows.

For congruity and fitness for every "person" likely to use clothes at all this list seems fairly to match the other.

* * *

Mr. Labouchere, one with whom I find myself in nine cases out of ten most heartily agreeing, and to whom I always feel grateful for the fine example he sets in saying plainly what many feel but seem afraid to say, very properly launches ridicule at a certain foolish person (I forget his "highly respectable name") who finds atheism in the theory of eternal motion. But he goes on to express the opinion that inquiries into the laws of evolution, and into matters metaphysical, are alike a waste of time. Now, with regard to metaphysics I have nothing to say—which means of course that I might say a good deal, but nothing favourable. If, however, there ever was a matter which was of vital importance to the human race, it is the theory of evolution. If the gradual progress of this theory had produced no effects, one might understand doubt as to its importance. But on the contrary, this theory as it has gradually been established and as it has still more slowly been accepted, has entirely changed the ways and thoughts of men. Such modes of thought as we recognise in Mr. Labouchere and others would have no existence now, but for the struggle made by thinking men in the last few generations to establish the doctrine of evolution in its general form,—in other words to indicate the prevalence of law and the fertility of lawlessness no matter under what high and sacred names it may be disguised.

* * *

Mr. A. Frederick Harrison falls into a similar mistake (I cannot but think it such) in treating the doctrine of evolution as merely expressing a mode of thought, instead of being (and having shown itself in action) one of the most potent factors of modern progress. "Is it enough," he asks, "to have a vague sentimental impression of some mystical harmony of the Universe, some shadowy Optimism that somebody or something must have ordered these things for the best: to hold the mind secure in that bastard philosophy of evolution, which is merely another form of *laissez faire*—the selfish acquiescence in evil, I mean, in the lazy pretext that everything is working itself out in the long run, whether it be for the best, or the worst, is not our affair, and whatever it be, it is not for us to meddle. How can any intellectual opinion about the laws of this material world in any case inspire a moral and social devotion to active duty? Devotion to duty, under a deep and abiding sense of our moral and social responsibility, needs to call in all the powers of our complex nature, all the secret springs of character and motive. We must appeal to men's sympathy as well as knowledge; to enthusiasm as well as convictions; to habits as well as to culture. Ambition, envy, covetousness, disorder, injustice, vanity, and mad recklessness, are passions so common in our social organisation and so frightfully dangerous to its peace, that we need every resource that we can get to curb and guide the movement of public life."

* * *

"When a real *human* religion," he proceeds, "has established its kingdom on earth—a religion with a code of earthly duty,—and a scheme to kindle earthly emotions and enthusiasms, all grouped round and issuing out of our sense of fellowship in humanity, and our part in the welfare of humanity—men will be trained from childhood to look on their great civic duties as amongst the noblest of all human obligations; public opinion will be elevated by the ever-present sense that a public function is a religious duty; the meanness of personal ambition will be confronted with a sense of the mighty and organic whole with which we are incorporate, or which we are defying. Sloth and selfishness in our public duties will be treason against humanity as well as disloyalty to our fellow-citizens. And as we debate and vote upon the questions of the hour, it will be ever present to our memory that our vote, be it wise or foolish, selfish or patriotic, is so far as in us lies, deciding the future of that greatest Power of which we have certain evidence on earth—the course of Human Civilisation, and is forming some infinitesimal atom in the life of Humanity."

* * *

All this is in reality, though he does not see it, the expression of what must actually result, what actually has already in part resulted, from the influence of the doctrine of evolution in its relation to man. When men generally accept the doctrine of evolution, they will

view human duties as Mr. Harrison would have them, and recognise a religion of humanity (by no means like the Positivists, however, in implying any enthusiastic admiration of humanity as it at present exists) depending on the sense that each one of us has power and will by which to aid, in greater or less degree, the progress of our race towards better things.

* * *

IT may be worth while, perhaps, to mention that on Feb. 14 I deliver a discourse on "The Past of Religion" at South Place Chapel, Finsbury; and another on "The Future of Religion," on Feb. 21, at a quarter-past eleven, morning.

New Books to be Read—and Why.

An Introduction to Practical Bacteriology. By EDGAR M. CROOKSHANK, M.B., F.R.C.S. (London: H. K. Lewis. 1886.)—Because the germ-theory of disease is now emphatically on its trial, and the ultimate decision of the pathologist must be based upon the result of experiments, the mode of making which is given in the most minute detail in Mr. Crookshank's excellent book. He has really produced a kind of small encyclopædia of the subject, in which the incipient student of bacteriology may learn everything about the apparatus needed for the prosecution of his researches, and the best and most effective methods of employing it. He is further taught the use of the microscope for the same purpose, and is instructed how to make preparations for viewing with it. The cultivation of the bacteria is next explained, and the methods of inoculation with them, and the examination of bodies affected by them given. Finally, a classification and description of those species of bacteria recognised as distinct, and an Appendix of varied information conclude the work. It is long since we have seen anything more beautiful or life-like than the majority of the numerous illustrations which adorn the volume before us.

Magnetism and Electricity. By H. C. TARN, M.C.P. (London: W. & R. Chambers. 1886.)—Because, while professedly written to enable students to pass in the first class in the elementary examinations at South Kensington, Mr. Tarn's small volume is commendably free from "cram," and places the leading facts of magnetism and electricity in an agreeable and apprehensible light. The constant reference to experiment, and the very numerous ones described and illustrated, will surely serve to render the work attractive to the beginner.

The Quickest Guide to Breakfast, Dinner, and Supper. By AUNT GERTRUDE. (London: T. Fisher Unwin.)—Because it contains *menus*, and *menus* alone, and supplies just the information needed by the housekeeper but too often driven to her wits' end for some change in a dreary and very circumscribed round of bills of fare. A *précis* of the way of cooking every one of the hundreds of dishes catalogued by "Aunt Gertrude" is appended to it.

Report of the East Anglian Earthquake of April 22nd, 1884. By RAPHAEL MELDOLA, F.C.S., &c., and WILLIAM WHITE, F.E.S. (London: Macmillan & Co. 1885.)—Because it gives a practically exhaustive account of a convulsion with which we are happily unfamiliar in England; tracing its phenomena, results, area of disturbance, dependence upon geological structure, &c., in a form calculated to render the ordinary reader slightly less confident perhaps than he may have hitherto been, that the soil of Great Britian is of absolute necessity *terra firma*. The astronomer will read with interest on p. 216, *et seq.*, of the alleged shifting of a large equatoreal, weighing something like a ton, by the passage of the earthquake wave.

How We're "Done"; or, Our Little "Do"'s. By ONE WHO KNOWS THEM. (London: Wyman & Sons. 1866.)—Because, at all events, it is amusing, and, under the guise of persiflage and "chaff," tells a large number of home truths, which it must be useful for every one to know and to remember. Its author's taste in places, is, however, of a questionable description; for while the chapters on quack medicines, music, picture-dealing, and the British workman are as good as they are true, the sneers at our Royal Family and the essay on the Church and clergy seem to us to be leavened with a spite as needless as it is unjust.

The Looking-glass; a true History of the Early Years of an Artist. By THEOPHILUS MARCLIFFE. (London: Bemrose & Sons. 1885.)—Because it is a facsimile reprint of the Biography of Mulready, the well-known Royal Academician, which was written by the notorious William Godwin under the *nom-de-plume* which appears on the title-page. Paper, print, and illustrations are all admirably reproduced, and give a capital notion of the style and appearance of the literature which delighted our grandfathers in their school-days.

Chemical Student's Manual. By H. L. BUCKERIDGE, F.C.S., &c. (London: Thomas Murby.)—Because it will be found valuable by the student who is undergoing a systematic course of instruction in chemistry, whether in the form of lectures or of laboratory practice. It takes the form of a series of notes of all points necessary to be thoroughly apprehended and remembered, is well illustrated, and may be commended.

The Prospector's Handbook. By J. W. ANDERSON, M.A., F.R.G.S. (London: Crosby Lockwood & Co. 1886.)—Because its author, having himself travelled through the rich mineral fields of New Zealand, New Caledonia, New Mexico, and Colorado, knows from actual personal experience the difficulties which beset the miner or prospector in his search for metals and ores in a new country, and is hence in a position to speak *ex cathedrâ* as to the best and most effectual methods of discovering and obtaining them.

The Dyeing of Textile Fabrics. By J. J. HUMMEL, F.C.S. (London: Cassell & Co. 1885.) Because it forms a concise little cyclopædia of the art of dyeing, and expounds in a simple manner the latest processes and methods in it.

Those who may wish to have their previous ideas subverted, and to be generally set to rights intellectually, may (if they choose) read *Hygienic Medicine*, by T. R. ALLINSON, L.R.C.P. (London: Pitman, 1886), who "runs a-muk" at the teachings of that College of which he proclaims himself a Licentiate, and proposes to regenerate mankind by limiting them to vegetable food, like the beasts of the field. Also *The Light of Life*, edited by JOSEPH JOHN KAIN (London: Wyman & Sons, 1885), in which vaccination is denounced, a new theory of development advanced, and so on. We have also before us *Notabilia of Greek Syntax*, by Rev. F. W. AVELING, M.A., B.Sc. (London: Relfe Brothers): Nos. 1, 2, 3, and 4 of *The New Explanatory Reader* (London: Moffatt & Paige). *The Jurors' Report of the Aëronautical Exhibition of* 1885 (Greenwich: H. Richardson), and Vols. IX. and X. of Mrs. HORACE DOBELL'S *Watches of the Night* (London: Remington & Co.).

Our Whist Column.

GAME I.

THE HANDS.

B { S (*trumps*). 10, 6. H. A. 9, 8. D. Q, 8, 4. C. A, 6, 7, 5 3. }

Y { S (*trmps*). 5, 4, 3 H. 3, 2. D. K, 10, 3, 2. C. Q, Kn, 9, 2.

B

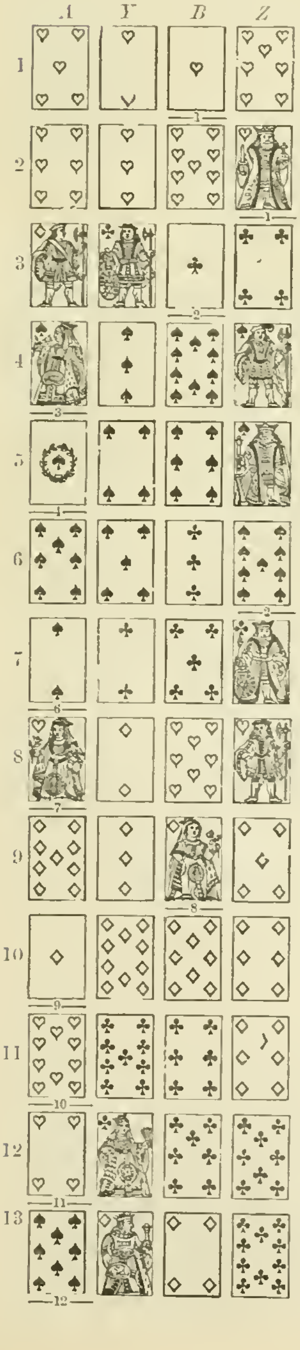
Y Z *Tr. S. K.*

A leads.

K, Kn, 9. K, Kn, 7. 7, 6. 5. K, 10 8, 4. } *Z*

A { S (*trumps*). A, Q, 8, 7, 2. H. Q, 10, 6, 5, 4. D. A, Kn, 9. C. Nill. }

Score :—Love all.



NOTES TO GAME I.

Note.—Card underlined takes trick, and card next below leads next.

1. With five of a suit and five trumps, *A* properly leads his suit and the penultimate card, which he would show upon the return if *B* had Ace, King, or the fall of the cards rendered it advisable.

2. It is clear from the return that *B* has not more than three. *A* conceals the penultimate, and from the fall of the cards the position of Heart Four is now uncertain. It may be with *B* or *Y*.

3. *A*, by the discard of Diamond Knight, must certainly be calling.

4. *B* is equal to the occasion, and leads through the King.

5. *Z* here properly plays a false card. By playing the Nine he would still be keeping the turn-up trump, thus making the position too easy for *A*.

6. But as *A* has the Seven and the Eight he is in no difficulty, even if *Y* should hold the two remaining trumps.

7. *Z* proceeds to force *A*; one trump remains in.

8. *A* is obliged to proceed with Heart Queen; the Knave might be guarded in the hand of either *Y* or *Z*.

9. *A*, who has nothing to lose, and is playing for five by cards, leads Diamond Nine. *Y* ought, at all risks, to play Diamond King. The fall of the cards ought to have made it clear to him that the remaining Hearts were with *A*. If *Z* had Diamond Ace it was immaterial. It is in such a position that skill tells. The rest of the hand plays itself.

Our Chess Column.

By Mephisto.

AN IMPROVED SCALE OF ODDS AT CHESS.

It is, indeed, an anomaly that, until now, we should have retained the same hackneyed scale of odds in use ever since the good old times. These odds are very unsatisfactory, as everybody knows who has ever taken part in a Handicap Chess Tournament. The objections against the old scale of odds are many. Theoretically, there is a fundamental defect in the scale. According to this, A gives B Pawn and one move, and to C Pawn and two moves: whereas B has to give C Pawn and one move. We maintain that B is unduly handicapped, the reason being that B ought to give to C merely the difference between Pawn and move and Pawn and two moves; but B actually gives C more than that.

The question what would be a fair equivalent of odds for B to give to C is easily answered. If—making allowance for the importance of the move—we substitute two moves for the one move difference between the odds of Pawn and move and Pawn and two moves, then we have fairly met the case. It will be admitted that a player giving the odds of the first two moves experiences a difficulty in the opening and development of his game. Now, as the odds of Pawn and two moves are merely Pawn and one move plus difficulty, therefore the odds of the first two moves, which are somewhat difficult to meet, are equal to the difference between the odds of Pawn and one move, and Pawn and two moves, so that whilst A gives B Pawn and move, and to C Pawn and two moves, B ought only to give the first two moves to C.

Theoretically nothing whatever justifies B to give to C the substantial advantage of a Pawn. Practically the result of experience is, if possible, still more conclusive. In most chess circles and clubs there will be found players whose play indicates that they are almost too good to receive Pawn and two moves, yet they are not advanced into the (so called) second, *i.e.*, the Pawn and move class, because in most instances they could not yield the odds of Pawn and one move successfully to the lower class. This fact clearly shows that there is something wrong, and leaves no doubt as to where the fault lies.

Most pronounced of any case is, secondly, that of the first class players. In this class there are now-a-days but very few players indeed whose chess talents satisfy all the conditions upon which a player in modern times is pronounced a first class player. But there are many players who undoubtedly possess great genius and ability for the game, who are mostly too strong to receive the odds of Pawn and one move from the first class, also too strong to play on level terms with Pawn and move players, but they are not strong enough either to play successfully against first class players on level terms, nor against the second class at Pawn and move.

Our proposition is to create a new class of odds, which would not only meet the case of the third-class players and that of the first and second-class players, but it would also effect an improvement in the lower classes, as we propose to create not only a fresh class between the first and second, but also two new classes between the Knight-classes and Rook-classes, the effect of which will be to bring about a more equitable and uniform distribution of odds, enabling a player to rise by gradual and easy stages.

Our proposition is that

First class give to second class the *first two moves*.

,,	,,	third	,,	*Pawn and move.*
,,	,,	fourth	,,	*Pawn and two moves.*
,,	,,	fifth	,,	*Knight.*
,,	,,	sixth	,,	*Knight and the move.*
,,	,,	seventh	,,	*Rook.*
,,	,,	eighth	,,	*Rook and the move.*

In references to the Knight and Rook classes, we think the case is on all fours with that of Pawn and move and Pawn and two moves. The difference between receiving the Knight or Rook with or without the move is a considerable increase of difficulty which is fairly balanced by an equivalent of two moves, which the player receiving the Knight without the move has to give to the player receiving the Knight and the move. We recommend our scale of odds to the favourable consideration of all concerned, and we may mention that this improved scale has been adopted in an important handicap

tournament which is now in progress at the well-known City chess resort at Purssell's, in Cornhill.

To show the distribution of these odds for all classes we give the following table, which explains itself :—

SCALE OF ODDS.

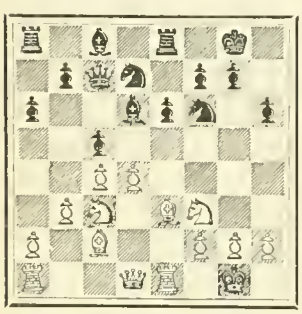
	Two moves.	Pawn and move.	Pawn and two moves.	Knight.	Knight and move.	Rook.	Rook and move.
Class 1 gives to Class	2	3	4	5	6	7	8
„ 2 „ „	3	4	5	6	7	8	
„ 3 „ „	4	5	6	7	8		
„ 4 „ „	5	6	7	8			
„ 5 „ „	6	7	8				
„ 6 „ „	7	8					
„ 7 „ „	8						

By testing this scale of odds in different directions, it will be found that in spite of the many improvements, yet in the main the class of odds are altered but very slightly. We give a few instances : —

A Pawn and two player (class 4) gives Pawn and two moves to a Rook player (class 7), the same as he always did. A Knight player (class 5) gives Pawn and move to a Rook player (class 7). A Pawn and move player gives Pawn and two moves to the weaker division of the Knight class only ; but he gives a Kt to the Rook class as before. The first-class player gives to all classes the same odds as before, materially improved upon by the interposition of three new classes—namely, the 2nd, 6th, and 8th.

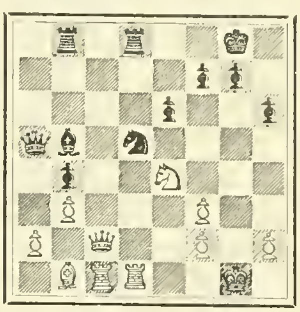
The following game was played on January 21 in the Handicap Tournament at Purssell's Chess-rooms. It is a good example of a game played at the odds of two moves :—

White. A. G. Guest.	Black. J. Gunsberg.
1. Kt to KB3	
2. P to Q4 (*a*)	P to Q4
3. P to B4	P to K3
4. P to K3	Kt to KB3
5. B to Q3	P to B3
6. Castles	B to Q3
7. Kt to B3	QKt to Q2
8. P to K4 (*b*)	P × KP
9. B × P	P to KR3
10. R to Ksq (*c*)	Castles
11. B to B2	R to Ksq
12. Kt to K5	P to QB4 !
13. Kt to B3 (*d*)	P to R3
14. B to K3	Q to B2
15. P to QKt3 (*e*)	



15.	P × P
16. Q × P (*f*)	Kt to K4
17. Q to R4 (*g*)	Kt × Kt(ch)
18. P × Kt	B to K4 (*h*)
19. B to Q4	B × B

White. A. G. Guest.	Black. J. Gunsberg.
20. Q × B	R to Qsq
21. Q to K3	P to QKt4 (*i*)
22. P × P	P × P
23. B to K4	R to Kt sq
24. QR to Bsq	Q to R4
25. KR to Qsq	B to Q2
26. B to Kt sq	P to Kt5
27. Kt to K4	Kt to Q4
28. Q to Q3 (*j*)	B to Kt4
29. Q to B2	



29.	P to B4 (*k*)
30. Kt to B5 (*l*)	Kt to KB5 (*m*)
31. K to Rsq (*n*)	B to K7 !
32. R to Ksq	Q to Rsq !
33. Kt to K4 (*o*)	B × P(ch)
34. K to Kt sq	P × Kt
35. Q to B4	R to Q4
36. B × P	R to Kt4(ch)
37. K to Bsq	B to Kt7(ch)
Resigns.	

NOTES.

(*a*) This brings about Zukertort's Queen's Opening, White being a move ahead. We think, however, that White would do better to play 1. P to K4 and Q4, preventing a regular Opening, and compelling Black to play a defence resembling the French.

(*b*) This is proper play now ; but it tends to show that it must be better to play P to K4 on the first move, instead of losing time by playing first P to K3, and then P to K4.

(*c*) With a view to advancing P to Q5.

(*d*) A serious loss of time. White might have simplified matters by 13. Kt × Kt, B × Kt. 14. P × P, B × BP. 15. B to K3, &c. White's object in playing his Kt back to B3 was to keep Black's QB blocked up.

(*e*) Compromising his position on the Q side.

(*f*) His best, for if 16. B × P, P to K4. 17. B to K3, P to K5, &c., winning the KRP.

(*g*) White preferred this move to retiring this Kt., as he evidently relies on the favourable position of his QB for attacking Black.

(*h*) White threatened B × P.

(*i*) An attempt to bring the QB into play.

(*j*) White's intention is obviously to get a chance of playing his Q to R7, even at a sacrifice ; for that reason Black had to be very exact in his moves.

(*k*) The only way of counteracting White's designs. If Kt to B5, then Kt to B6(ch) wins. R to Bsq would also be fatal. P to B4, however, required proper examination, for there was the possibility of White attacking the weakened KP successfully, or taking it off even if protected, followed by Q × P.

(*l*) Playing as indicated above. But we think Kt to Kt3 would have been more defensive, as it guards the square on K7, which Black is endeavouring to reach with his Kt.

(*m*) This move defends the KP, for if 31. Kt × P, Kt × Kt. 32. Q × P, Kt, Bsq safely. The move is also very attacking, threatening Kt to K7. Again, if White plays R × B, the Black Q retakes, threatening to mate as follows :—31. R × R(ch), Q × R. 32. K to Rsq, Q to Kt4. 33. R to KKt sq, Q to R4, followed by B to B3, &c.

(*n*) This loses right off. 31. R to Ksq was best.

(*o*) White has no other defence against Black's last move.

STEINITZ *v.* ZUKERTORT.

The first part of this match is now concluded, and resulted in a decisive victory for Zukertort, who won four games to one.

The following vigorously-played game is the first of the match, commenced on Jan. 11, at New York :—

White. Zukertort.	Black. Steinitz.	White. Zukertort.	Black. Steinitz.
1. P to Q4	P to Q4	24. K to Ksq	Kt to Kt5
2. P to QB4	P to QB3	25. B × Kt	B × B
3. P to K3	B to KB4	26. Kt to K2	Q to K2
4. Kt to QB3	P to K3	27. Kt to KB4	R to R3
5. Kt to KB3	Kt to Q2	28. B to B3	P to Kt4
6. P to QR3	B to Q3	29. Kt to K2	R to B3
7. P to B5	B to B2	30. Q to Kt2	R to B6
8. P to QKt4	P to K4	31. Kt to KBsq	R to QKt sq
9. B to K2	KKt to B3	32. K to Q2	P to B4
10. B to Kt2	P to K5	33. P to R5(?)	P to B5
11. Kt to Q2	P to KR4	34. R to KRsq	Q to B2
12. P to KR3	Kt to Bsq	35. QR to Ksq	P × P(ch)
13. P to QR4 (?)	Kt to Kt3	36. Kt × P	R to B7
14. P to Kt5	Kt to R5	37. Q × R	Q × Q
15. P to Kt3	Kt to Kt7(ch)	38. Kt × B	B to B5(ch)
16. K to Bsq	Kt × P(ch)	39. K to B2	P × Kt
17. P × Kt	B × KtP	40. B to Q2	P to K6
18. K to Kt2	B to B2	41. B to Bsq	Q to Kt7
19. Q to KKt sq	R to R3	42. K to B3	K to Q2
20. K to Bsq	R to Kt3	43. R to R7(ch)	K to K3
21. Q to B2	Q to Q2	44. R to R6(ch)	K to B4
22. P × P	P × P	45. B × P	B × B
23. KR to Kt sq	B × P(ch)	46. R to Bsq(ch)	B to B5

White resigns.

Contents of No. 3.

KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART

LONDON: MARCH 1, 1886.

SUN WORSHIP.

By Richard A. Proctor.

BEFORE entering on the discussion of a portion of the matter belonging to my subject, "The Unknowable or the Religion of Science," I may explain why for the present I drop that heading. There is a prevalent idea—which is as much as saying there is a foolish idea—that when a student of science speaks about religion he speaks as an opponent. And although my series of papers on the Religion of Science have heretofore not even touched on prevalent religious ideas, the use of a heading in which the word religion occurs is regarded by many, which again is as much as to say that it is foolishly regarded, as indicating that before I have done I shall make some desperate attack on ideas which many regard as especially sacred. Now, as I said at the outset, I have no such intention. I propose only to show how to the student of the universe thoughts essentially religious present themselves, how on the one hand, a power outside ourselves making for righteousness becomes more and more clearly apparent to him the more he studies the past of his race, and how on the other hand recognising the Unknowable as Infinite the nature of the Unknown Reality existing in and through all things as Inconceivable, he has that which all true religion postulates, Infinite mystery, by which mere morality, moved by the emotions, becomes religion. The student of science does not complain when the advocates of contending religions describe the features of their several systems of theology. He is not angry when he sees the many (therefore the unwise) denying the Infinite by limiting It within Personality, or blaspheming the Unknowable by pretending to know that It is moved by mean and paltry passions such as affect themselves. If science, thus recognising prevalent Infidelity,* is silent so far as rebuke is concerned, she may yet be permitted to express her own faith—her belief in an Infinite Power outside ourselves making for righteousness, her recognition of the prevalence of law throughout all space and during all time.

Although probably sun-worship long preceded the full development of agriculture, it was certainly among agricultural races that sun-worship first reached its full development. Men who lived by hunting and fishing, and those still more who trusted to pastoral labours for the means of sustaining life, must have been moved by the glory of the sun, by the impressive beauty of the phenomena attending dawn and sunset, and even by the evidence of waxing and waning might presented by the sun throughout the year. In our dull humid climes we can hardly understand the effect which solar phenomena would have on races living nearly all the time in the open air, and witnessing day after day and year after year the ever-changing glories of the orb which is lord alike of the day and of the year. The phenomena of dawn and sunset in particular are impressive in tropical and subtropical regions to a degree which in our gloomier latitudes we can hardly even imagine. The very animals respond to the touch of the sun's first rays with such a concourse of vocal recognition that by comparison the song of the lark in our own lands seems a tame and feeble tribute to the rising ruler of the day. One might even imagine that some animals, as our near relatives the Gibbons, were moved by a feeling of actual adoration, so earnestly do they welcome, both by voice and by gesture, the rays of the returning sun. Beautiful as are the lines in which our poet laureate describes the dawn of day in England, they would seem utterly tame and unmeaning to one accustomed to the magnificent dawn—the veritable day-spring—of less humid regions. He tells us how

—— sucked from out the distant gloom
A breeze began to tremble o'er
The large leaves of the sycamore,
And fluctuate all the still perfume.

And gathering freshlier overhead,
Rocked the full-foliaged elms, and swung
The heavy-folded rose, and flung
The lily to and fro, and said,

The dawn, the dawn! and died away,
And east and west, without a breath,
Mixed their dim lights like life and death
To broaden into boundless day.

A most perfect and realistic description, truly, of the dawn as best known here; but not one word of the glorious colours which flood the skies before the day-spring of tropical and subtropical regions. A Syrian or Egyptian would hardly know that the dawn was meant, in a passage which spoke only of still perfume, freshness, full-foliaged trees, the heavy folded rose, and dim lights mixing like life and death. There is no dimness, no suggestion of death, in the dawn as again and again I have witnessed it in the Carolinas, Louisiana, and Texas, or on the other side of the equator in Australasia. In the tropics the display is even grander, but the changes develope so swiftly that almost ere one has had time to feel their full grandeur, the monarch of day is rising in full glory. In the actual dayspring, again—in sunrise itself—there is something strongly, one might almost say imperatively, suggestive of might and purpose. The sun seems to rise like a living thing, aye like a sovereign monarch. He seems to survey his own realm as his glowing orb rises. And if this is so to the modern student of astronomy, how much more impressive must the scene have been to those who as yet had no knowledge by which the thought could be corrected, that the sun has consciousness and will as well as mere material might.

The first recognition of the sun as a power, not only influencing the fortunes of men but bearing sway over the earth in his daily rule, may well be assigned to pastoral or even to earlier races, though the recognition of the sun as God of the Year belonged probably to agricultural races, and the worship of the sun as a mighty monarch to the development of civilisation. We cannot from any study of the actual methods of worship, deter-

* The student of science who recognises the Power outside ourselves as Unknowable, who admits that he "cannot by searching find out God" is absurdly called an atheist—probably oftenest by people who do not know what the word means: if he cared to descend to calling names, he might much more truthfully apply to those who thus name him, the counter-title—cacotheists.

mine the time to which their origin must be assigned. For customs which had at first no religious significance became developed in the course of time into religious observances; and religious observances, interpreted in a particular way at one time in the history of a race, obtain an entirely different interpretation at another time, and often pass through many changes of meaning before they pass out of use,—if they ever entirely disappear.

Thus we cannot suppose that the Egyptians or ancient Babylonians, had their religion begun with sun worship, would have offered sacrifices to their god, seeing that the idea of offering flesh or meal to the sun, as to a being which could take pleasure in such offerings, would be scarcely less absurd than the idea of offering the flesh of lambs and goats to the Infinite Energy from which all things proceed. But if offerings of food had been made to animals in earlier times, first with very practical ideas as to the utility of such sacrifices and later as propitiatory offerings to animals regarded as deities, it is certain that when sun moon and stars came to be worshipped instead of nearer and less dignified bodies, offerings of flesh meat, of corn, of oil, and so forth, would be made to these new and higher gods, despite their apparent inability to avail themselves of such offerings. If they could not eat the flesh of a burnt offering, the smoke of it, rising to the skies, their home, might reasonably be thought to savour sweetly to them. And so might offerings of meal and oil be pleasant to the gods in the heavens though the substance remained unconsumed—till at least it passed into the possession of the priests who enjoined these sacrifices.

That sacrifices were offered to the sun while as yet he was only regarded as lord of the day, is rendered probable by the continuance of the morning and evening sacrifices among the Jews, even when sun-worship had long since been rejected as an offence—as Job puts it—against the God who is above the sun and moon. It is curious indeed to find Jewish law-givers apparently retaining the very words of the old ordinances, long after these words had wholly ceased to be applicable—so hardly do religious observances die even when the religion to which they belonged has long been wholly dead.

Thus only, as it seems to me, can we explain the strangely archaic wording of the injunctions in Numbers regarding the morning and evening sacrifices, doubtless remnants of the very oldest observances of sun-worship:—"The Lord spake unto Moses, saying, Command the children of Israel, and say unto them, My oblation, my food for my offerings made by fire, of a sweet savour unto me, shall ye observe to offer unto me in their due season. And thou shalt say unto them, This is the offering made by fire which ye shall offer unto the Lord; he-lambs of the first year without blemish, two day by day for continual burnt offering. The one lamb shalt thou offer in the morning, and the other lamb shalt thou offer at even; and the tenth part of an ephah of fine flour for a meal offering, mingled with the fourth part of an hin of beaten oil. It is a continual burnt offering, which was ordained in Mount Sinia (!) for a sweet savour, an offering made by fire unto the Lord. And the drink offering thereof shall be the fourth part of an hin for the one lamb: in the holy place shalt thou pour out a drink offering of strong drink unto the Lord. And the other lamb shalt thou offer at even: as the meal offering of the morning, and as the drink offering thereof, thou shalt offer it, an offering made by fire, of a sweet savour unto the Lord."

How long these offerings continued, and how vain they were thought by the more advanced minds, we can judge by the impassioned language of Isaiah, "Hear the word of the Lord; to what purpose is the multitude of your sacrifices unto me? saith the Lord. I am full of the burnt offerings of rams and the fat of fed beasts; and I delight not in the blood of bullocks, or of lambs, or of he goats." But such teaching was of no avail among the unreasoning many in his day, any more than it would have been in the days of sun-worship, or indeed than it would be now. Doubtless he was regarded as an enemy of religion in his own time, however he came to be reverenced when the opportunity for following his precepts had passed away. His rejection of what nearly every one in his time accepted, was no doubt looked on as implying agnostic if not atheistic ideas.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By Edward Clodd.

V.—THE PAST LIFE-HISTORY OF THE EARTH (*Continued*).

The *Devonian* and *Old Red Sandstone* rocks, while evidencing to frequent redistribution of sea and land, have undergone, as compared with the older systems of the Primary epoch, but slight disturbance from the upheaving and contorting agencies beneath. They are widely diffused, extending far north within the Arctic circle, and although their fossil contents are very incomplete, they bring less fragmentary witnesses to that continuity of life which is so markedly broken in more ancient deposits. This is specially apparent in the relative abundance of vegetable remains, by which we may for the first time construct some picture of plant-life on the globe in the Palæozoic epoch. Not only do we find huge tree-like plants of which our club-mosses and ferns are pigmy representatives, but true trees, as proven by the concentric rings of growth in their trunks. Of land animals, the preservation of which is so rare in all deposits, there are no traces; no reptiles wallow in the lagoons and marshy flats, neither are the verdant yet flowerless forests brightened by the plumage, or their stillness broken by the song, of birds. Some happy chance, like that which envelopes the insects of Tertiary forests in amber—the fossil gum and resin of their trees—has preserved the fragile wing of an insect with the drum or stridulating organ attached, as in the grasshopper, &c., wherewith then, as now, mates were attracted or rivals challenged; perchance "the first music of living things that geology reveals."

Freshwater fossils abound; but the dominant types are marine; large sponges and corals; "lamp-shell" mollusca, which have persisted in varying forms from Cambrian times till the present; crustaceans huger than any that have lived since, and of which even the spawn-masses are sometimes preserved. More or less special types appear, and then vanish, through inability to adapt themselves to new surroundings and changed climates. But the Devonian is notably the "Age of Fishes," and its waters swarmed with the ganoid or armoured type.

Coal is formed of compressed and chemically-altered plants, and therefore occurs in all water-laid rocks, although in very different states and kinds. The climate and soil, during long eras of the *Carboniferous* system, specially favoured the growth of plants most fitted for its formation. A large part of Europe (and the like conditions apply wherever the true coal-measures abound) was then covered with shallow waters, both salt and

fresh, divided by low ridges—bases of future mountain chains—and dotted with islands; numerous rivers traversing the land and silting up lagoons and lakes with the *débris* worn from older rocks. Vegetation flourished apace on these river banks and marshy flats, and, with intermittent subsidence of the soil occurring again and again, was buried under sand and mud, and changed into coal of varying seams of thickness. Hence the abundance of this mineral in the Carboniferous strata, which, as a whole, yield more of value and variety for the service of man than all the other systems put together. Sandstones for building, marbles for decoration, metals for machinery, coals wherewith to drive them, purest oil from muddy shale, loveliest colours from tar, jet for the lapidary's art—these are the rich gifts of the deep rocks.

Of the plants forming the coal-measures, the larger number are obliterated, but they all belong to the lower orders, as do the club-mosses, tree-ferns, and other forms, which, in the warm, moist atmosphere of those times, reached a gigantic size, and had a worldwide range, even far into Polar regions, where coal-seams have been found. Of the animal life that dwelt amongst them we know very little, nor do the extant fragments represent a tithe of the forms then flourishing; in the later deposits the lower sub-kingdoms are represented by spiders and large scorpions; by land-snails, beetles, may-flies, and other insects; while the first-known land vertebrates appear in the salamander-like and long-extinct amphibians called Labyrinthodonts, from the labyrinthine structure of their teeth.

As usual, the marine remains are dominant. The lower types persist; the trilobites are on the verge of extinction, but higher forms of the same group, allied more nearly to the lobster and the shrimp, succeed. Forerunners of the beautiful ammonites appear, and the fish, while still of the armoured species, have a more reptilian character than their Devonian ancestors.

The life-features of the *Permian* system, the last division of the Primary epoch, differ but little from those of the Carboniferous; the only, although important, distinction is in the remains of true reptiles with crocodile-like characters.

We now leave the Primary epoch, and enter the Secondary epoch, with its widely different features and contents, explicable only by a great break in the succession of strata, and by an enormous lapse of time for the modification of the life-forms. Although, as in every period, volcanic action is manifest, the igneous rocks being pushed through the strata, or now and again alternating with them, we meet with few traces of the metamorphism which so baffles examination of the earlier rocks; we can mark more definitely the boundaries of land and water; measure more accurately the changes; and trace more clearly the relations between the successive life-forms, of which the marine are the preponderating, and the reptilian the most marvellous.

In the earliest division of this epoch, the *Triassic*, many of the leading Palæozoic types are extinct. Several plants of the Coal and Permian systems have disappeared, and the flora consists mainly of ferns, of cycads or palm-ferns, and of conifers, or pines and firs, to which the cycads are allied. Among the invertebrate animals, certain molluscs are no longer found, but there is an intermingling of old and new types. Oysters and whales and members of the cuttle-fish group are abundant. As yet the fishes show no marked advance in structure, and the Amphibia are changed only in size, as their enormous footprints show. Reptiles allied to the crocodile group are now the dominant type; and sea-lizards, which attained gigantic size in later periods. Whether certain bipedal footprints in the Triassic sandstones are those of birds is doubtful; perhaps they are tracks of reptiles with bird-like movements. But, in the absence of proof that they are due to birds, which certainly preceded mammals in the succession of species, a great link is missing in the Trias, since that system has yielded teeth of the earliest known mammal. It was probably of the marsupial or pouched species, a transitional form now represented most nearly by the Australian phalangers and the American oppossums.

The *Jurassic*, or Oolitic, system occupies extensive areas in both hemispheres, and ranges from the Arctic circle to Australia. Its strata, largely composed of coral growths and other organic remains, are rich in special life-forms which are limited to the Secondary epoch.

Its seas, which overspread the greater part of Europe, covering the large salt lakes of the Trias, swarmed with exquisite spiral ammonites, large and small; with conical bolt-like belemnites, allied to the cuttle-fish group; with lobsters, prawns, and crabs, which succeeded the trilobites and other crustaceans; with ganoid fishes, sharks, and rays. And "there were giants in those days"; monsters of the deep in the ferocious sea-lizards, with their fish-like bodies and flipper-like limbs; monsters of the land, too, of dread aspect and size seen neither before nor since; one found in North American beds being, it is computed, more than one hundred feet in length and above thirty feet in height. There were flying lizards, winged like bats, hollow-boned like birds, and with claws, skin, and, teeth like reptiles; and it is in a Jurassic limestone stratum that the oldest known true bird, a creature about the size of a rook, is found. It does not correspond to any known past or present birds, but represents a transitional type, having both bird and reptile-like characters. In addition to free claws to each wing, the tail is long, and made up of separate bones or prolonged vertebræ, a feature noted in the embryos of birds and mammals, the significance of which will appear later on.

Therefore, while the sea, then, as ever, was the more thickly peopled, the land had now a far more important air-breathing population both of small things and great. The hum of insect-life filled the cycadaceous forests, butterflies sported in the sunshine, spiders spread their webs for prey, and the remains of marsupials point to the range of these small but highly-organised creatures over Western Europe. The plants and animals of these islands in Jurassic times probably resembled those still found in Australia, which, by reason of its long isolation from other continents, has preserved in its pouched mammals, its sharks, its mud-fish, and its cycads, more ancient life-forms than any other country.

The vast chalk formations of the globe are the typical features of the *Cretaceous* period (Lat. *creta*, chalk), when the sea overspread a large part of Europe, Asia and Northern Africa, receiving on its floor the foraminiferal shells which were converted into chalk, just as at this day chalky ooze is being deposited at the bottom of the Atlantic. Molluscs, nautiluses, belemnites, ammonites, some of them the size of a cart-wheel, swarmed in its waters; and with them the huge reptiles of Jurassic times, sea-lizards and sea-serpents, ganoids and sharks, and, what is important to note, bony-skeletoned fish allied to the salmon, herring, and perch families.

In the North American formations, which have so added to our knowledge of ancient life-forms, "dragons of the prime," crocodile-like, bird-like, bat-like, are found, as also the remains of true birds, these last being

rare in the Old World. Little trace of the Cretaceous land-areas remain, but the plants of the upper strata resemble existing vegetation; in the words of the science books, Angiospermous exogens appear, which in the vulgar tongue means leaf-bearing trees having a true bark (except cone-bearers), and growing from the outside, with their seeds enclosed in a vessel, as the oak, beech, willow, fig, walnut. They are called "exogens" in contrast to "endogens," or palms, grasses, and lilies, which have no true bark, and grow by additions from the inside.

Of the total thickness of the stratified rocks, estimated at 130,000 feet, the Secondary systems occupy only 15,000, or $8\frac{2}{3}$rds of the whole. But, as this abstract of their contents shows, their importance is not to be measured by the space which they fill. Whether or not transitional forms, which from their nature had a shorter range of time and less chance of preservation, existed in the Primary systems, we cannot say, for life is older than its records. But it is in the Secondary, when, as the coal-seams and coral deposits of extreme northern zones show, warm climates prevailed, that the marked advance in specialisation of plant and animal forms is manifest.

PHOTOGRAPHING FIFTEEN MILLION STARS.

By RICHARD A. PROCTOR.

A MAGNIFICENT suggestion has been made by French astronomers. Already in these columns the work done by the photographic eyes of science, directed towards the heavenly bodies, has been dealt with. By the power of instantaneous vision which the photographic eye, unlike the human eye, possesses, the sun's cloud-laden surface has been delineated, despite the constant fluctuations of the air through which the sun has to be viewed. By the power of selecting special colours wherewith to work, the photographic eye has drawn the corona when no trace of that solar appendage has been visible to ordinary eyesight. The delicate features of the star-clouds have been depicted, through the power which the photographic eye possesses, of seeing more and more by long-continued gazing upon faintly luminous objects. And now it is proposed to do what assuredly no astronomer, nor any band of astronomers, could hope to effect, even if working for the whole duration of the longest life. It is proposed to chart in their true positions all the twenty millions or so of stars which are included in the first fifteen magnitudes, so that the astronomers of future generations may know for certain the aspect of the stellar heavens—to that vast depth, at least—towards the close of the nineteenth century. Let us see what are the conditions of the task.

Using a telescope provided with a specially prepared object-glass of about 13 inches in diameter, MM. Paul and Prosper Henry have been able to take in a single hour photographic charts of spaces in the heavens extending 3 degrees in length and $2\frac{1}{4}$ degrees in breadth—say six moon-breadths by four and a half. Their actual plan has been to give in each case three exposures, with such slight displacements that each star is tripled, and so there can be no possibility of mistaking accidental dots on the plate for stars in the heavens. (It might be well, however, if in the photographs finally prepared only single images of each star were given, a preparatory plate with triple images serving for the correction of the one finally prepared, which might have three hours of exposure without displacement.) Now, a space of 3 degrees by $2\frac{1}{4}$ degrees on the heavens, or $6\frac{3}{4}$ square degrees, is about 1-6,112th part of the whole star-sphere. So that if twelve observatories, in different parts of the northern and southern hemisphere, were employed to photograph the star-sphere on one and the same plan, then at each observatory only about 510 plates would have to be made. Counting about fifty-one moonless nights of clear sky and still air, one night being given to each plate, the whole work would be completed in ten years. If the charts thus obtained could be combined in sets of four, in the manner already employed by MM. Henry, there would be 1,528 sheets, each representing a portion of the heavens, extending 6 degrees by $4\frac{1}{2}$; but although Admiral Mouchez suggests this plan as desirable, it appears open to exception on account of change of scale near the edges of the plates.

The number of stars which would probably be shown in this splendid contribution to the astronomy of the future would be about twenty millions. In a single plate, obtained by MM. Henry recently, nearly 5,000 stars can be counted; and if 6,112 gave each such a number—say 6,000 times 5,000—that would be 30 millions of stars. But the region shown in this particular plate belongs to a rich part of the Milky Way, and it has been shown by my chart of 324,000 northern stars down to the 10th magnitude, that there is a much greater density of stellar aggregation on the Milky Way long before the space-penetrating powers have been employed which the Herschels thought probably necessary to reach the regions whence the nebulous light of the Milky Way was supposed to proceed. If the photographic method were applied uniformly over the whole heavens, with a space-penetrating power reaching stars of the 15th magnitude in all directions, it is probable that about 20,000,000 stars would be shown. The great gauging telescopes used by the Herschels would show at the very least 100,000,000—or rather would have shown that number if it had been possible to bring every portion of the star-sphere under their survey.

A new era of stellar astronomy will open with this photographic work. The problems connected with the architecture of the heavens, hitherto dealt with by very imperfect methods, will now be discussed with all the advantage of at least a perfect system of survey. It is impossible, indeed, to overestimate the advantage of a system of charting over all the methods of statistical research which astronomers formerly employed. William Herschel in his first method counted all the stars which one and the same telescope—a very powerful one, 18 in. in diameter—would show in different directions. He could only take a field of view here and a field of view there, not many hundreds in all, his son and worthy successor in the work making similar observations in the southern hemisphere. No peculiarities of arrangement, nothing, in fact, but the roughest features of stellar distribution, could be recognised by such a method as this. It showed, however, how vast the number of stars forming our galaxy is, and it satisfied Sir W. Herschel that the assumption by which he had proposed to interpret his numerical gauges was inadmissible, the stars not being strewn throughout our galaxy with any approach to uniformity. Herschel's second method, commonly confounded with his first (insomuch that one may often find even men like Arago and Humboldt mixing up in the same paragraphs the results of both methods of observation) was entirely different. He

now no longer trusted to the use of the same telescope, turned in different directions, to tell him (after mere counting) the depth of our galaxy of stars in those directions; he turned different telescopes, gradually increasing the space-penetrating power, in the same direction, to tell him, by the power required to resolve the whole field of view into stars, the probable extension of the system in that direction. Herschel made many observations by this method, but in his advanced old age, when these observations had been gathered together, he did not recognise the absurdity of the result to which they tended, on the assumption he had employed. He found regions of the star-sphere, for instance, wherein stars of all orders were richly strewn, from those visible to the naked eye down to the faintest which his most powerful telescopes could show, and fainter orbs yet, whose lustre could only be recognised as milky nebulosity (resulting from the combination of the light of many stars separately undiscernible). Around these rich regions were regions comparatively poverty-stricken, regions deserving the description applied by the younger Herschel to the spaces around the Magellanic Clouds, of which he wrote that "the access to the nubeculæ is on all sides through a desert." If his assumption had been correct, these seeming clouds of many varied orders of stars, brought into view successively with increase of telescopic power, would be long cylindrical star-clusters, or rather spike-shaped projections of star-strewn space, hundreds of times longer than their thwart breadth, and chancing by some strange accident to have their axes directed exactly towards our place in the star system. Unlikely, one may almost say incredible, in a single case, this peculiarity would be utterly impossible in several; and the clouds so to be interpreted (if Herschel's assumption were retained) are many.

Obviously we must reject this porcupine theory of the stellar system, with the solar system for the "pole" of all the stellar spines. We see that the rich cloud-like regions are real clouds of stars of many varied orders, and that in each case where Herschel had assumed (though only tentatively) that he was penetrating further and further into space, he was in reality only analysing more and more scrutinisingly a complex cloud of stars. His position might be compared to that of an observer trying to gauge our solar system from a distance, who might naturally assume at first that the giant planets were much further away than the sun, the terrestrial planets much further away than the giant planets, the asteroids than the terrestrial planets, the meteorites than the asteroids, the small meteors than the meteorites, and the still smaller particles in comets' tails than meteors; such an observer, as soon as he recognised the association of all these objects into a system, would see that, instead of attributing the variety of aspect within the system to the variety of distance, he must regard it as due to real variety of size. The meteors which he had interpreted as millions of times more remote than the giant planets, he would now find to be in many cases close alongside of those large bodies, and, on the average, no further away than the chief orb in the system, the great controlling sun. In like manner the faintest stars in the great clustering regions of the Milky Way are, on the average, no further away than the leading orbs in the same star-clouds (which, be it noticed in passing, is by no means the same as saying that the fainter stars of the stellar depths are, on the average, no farther away than the more conspicuous). The assumptions made by the elder Herschel, though shown as his work proceeded to be mistaken, did not prevent his accumulated results from being most valuable. But the validity of statistical methods was shown to be doubtful. The assumptions of Wilhelm Struve were still more improbable antecedently, and still more thoroughly discredited by the evidence. He took a zone of the heavens 30 degrees wide, assumed that the stars (down to the eighth magnitude) might be supposed to be first compressed along the mid-line of that zone, and then strewn out uniformly in twenty-four sectors, into which he divided the circular area enclosed by that mid-line. This naturally led to a result having no validity whatsoever.

The fault of all such statistical methods is that in effect they depend on a process of averaging by which, even if the initial assumptions were trustworthy, the significance of all the actual peculiarities of stellar architecture would be concealed. We want to have these peculiarities emphasised rather than hidden. Charting alone can do this effectually. But who can pretend to chart the whole heavens to any great depth around our solar system? Struve used in his statistical inquiries about 70,000 stars, and I has shown in a single equal-surface chart 324,000; but what are they among tens of millions of stars within the range of Herschel's gauging telescopes? That single chart required first seven yesar of observatory labour by Argelander and his assistants, then 400 hours of charting by myself; yet it shows only stars down to between the ninth and tenth magnitudes, and even in regard to these is affected by all the variations arising from the "personality" of the different observers. The proposed photographic survey would extend very much further into surrounding space, would be far more trustworthy, and would be entirely independent of "personal equation." The idea is a magnificent one, and it may be hoped that the astronomers of all nations will help in carrying it out.—*Times.*

EVOLUTION OF LANGUAGE.

By Ada S. Ballin.

III.—SENSE-CHANGES.

LANGUAGE may be regarded as a tool of the human mind, an instrument serving two fixed purposes—namely, the expression and record of thought. The changes in the pronunciation of words may be compared to the wearing down and smoothing of the handle of such a tool which renders it more easy and comfortable to work with; but there are changes of more importance than these—namely, changes in the method of using the tool in which it is adapted perforce to the new purposes it is required to serve. As new ideas are evolved, it is found necessary to express them, and to this end old words are adapted, or, as it were, attached to the new meanings by a process based on the principle of SIMILARITY. In like manner, as I pointed out when speaking of the deaf and dumb,* that their chief means of communicating ideas was by indicating likeness, as by touching their lips to express "red," so with verbal language, new ideas are expressed by describing them in terms of the old. Thus it is that the meaning of words change by their being applied to ideas other than those which they formerly expressed. The similarity which

* KNOWLEDGE, vol. VII., in the series on "Thought and Language."

first caused the adaptation of an old word may, to an analytical mind, often seem very faint, although sufficiently apparent to the mind of the child or uncultivated man. By metaphor we speak of the *eye* of a needle; *ness* at the end of geographical names is derived from *nez, nose*, for a promontory of land. *Donkey* is the diminutive of *dun*, a horse; *daisy* is by a poetical figure *day's eye* (Saxon, dagges-ege); and the South Sea Islanders used to speak of man as *long pig*—a name said to be based on similarity of flavour. In like manner as among the deaf and dumb* single characteristics are taken to express the whole idea, as *snow* for *winter*, *petticoat* for *woman*, in Latin a *scale* for a *fish*, *sail* for a *ship*. Thus we speak of *bile*, meaning anger in the sense that Horace used the word *stomachius*. The word *savage*, in the sense of fierce, is derived from *savage*, meaning a wild man or animal, from the Latin *silvatico*, woodland, in the original sense of being reared in the wood in opposition to domestic, brought up in the house, or cultivated. A *junketting*, or merrymaking, is derived from the Latin *juncus*, a reed, through the Italian *junkala*, a cream cheese put up in reeds, and originally meant a party invited to partake of the comestible called *junket*. Our word *spirit* has the various significations:—Alcoholic liquor, courage, ardour, soul, ghost, and most immaterial things. French *esprit* is derived directly from the Latin *spiritus*, literally a blowing of the wind or breath; the word *ghost*, connected with our *yeast*, is also derived from a word meaning breath or blowing. The word *mail*, French *malle*, a trunk, means a box or bag for the conveyance of letters, also the coach or carriage in which the bags are conveyed; and we now talk of catching the *mail* when we mean being in time for the steamer or the train, or receiving the *mail* when our foreign letters arrive. The word *brim*, which we use for the *brim* of a hat, the *brim* of a glass, the *brim* of a fountain, and when we speak of tears as *brimming* over from the eyes, is derived from a Sanscrit root, *bhram*, meaning to whirl about, used in the sense of the surge of the sea, and thence by a natural transition of the borderland between the sea and the dry ground, the part where the waves whirl about the most, the *edge* of the water, thus reaching the sense in which we employ it.

The power of seeing likeness in diversity, which is the cause of words being used metaphorically, is strongest in uncultivated minds, such as those of savages and children. Thus, the little boy Clifford, whose early stages of development have been chronicled by Mr. Lully, at seventeen months began to have abstract ideas of form, and to express them. Having learned the word *bŏ* for indiarubber ball, he applied it to oranges, and afterwards to bubbles on a glass of beer. He saw likeness to the exclusion of difference, and formed a word for it, just as the Tasmanian calls everything *round*, "like the sun," by naming it after the round object most familiar to him. At twenty-one and a half months, Clifford called all triangular objects "ship," because the feature which had most attracted him about a ship was the triangular sail. He was so apt at observing similarities that when eighteen months old he saw his sister dipping a crust in her tea, he exclaimed *ba!* (boat) with much delight; seeing a dog panting after a run, he said, "dat bow-wow like puff-puff;" and of a ship he saw sailing, he said, "dat ship go marjory daw" (indicating the rocking movement by a simile from the poem, "See-saw, marjory daw"). As a still more striking example of the tendency to see similarity above difference, he called the needle in his father's compass "bir" (bird), detecting a resemblance in its fluttering action, which our more analytic minds would overlook.

It is to the same mental process here illustrated in the case of this child that language is mainly developed in the race. We talk of an *axle-tree* or of a *family tree* by a metaphor growing out of the idea of branches represented by the spokes of the wheel and the members of the family. Again, we talk of the *root* of the tongue, the *uprooting* of a superstition, the *root* of a figure in mathematics, the *root* of a word, by metaphor from the original meaning of the *root* of a tree or plant. In the first case, the point of similarity is the idea of fixedness, the second case that of destruction, by removing the growth from the place where it is nourished; in the others the idea is that of fundamental element.

The succession in the sense-changes of words is like a chain of many links. If we have only the first and last links we do not see how to connect them; but a careful search and fitting together will frequently reveal the connection. The series of changes is not necessarily a conscious one. Seeking to express an idea as yet unnamed, a word is chosen which has been used for some idea similar to it. This word is adopted, and in its new sense becomes a part of language, and gradually the old sense is forgotten and drops out of view. Then the word may be reapplied in another sense, and its second meaning also drop into oblivion, and so on. In this way a word may eventually come to possess a meaning totally opposed to its original sense. Thus, for instance, the German word *schlecht* originally meant good, *ein schlechter Mann*, a good fellow; then plain, simple, foolish, mean, base, bad. The French *bon* has a somewhat similar history, for, besides good, it means simple and silly; *bonhomme* means simple fellow, vulgarly old buffer or old codger, and *la lui garder bonne* is to owe any one a grudge. When we speak of a *pen* we now mean a steel pen, ignoring the origin of the Latin word *penna*, a feather, so far as to ask for a *quill pen* if we require that kind. When speaking of the *salary* of an employé we mean a sum of money, and never for a moment imagine that the word is derived from the original custom of paying the Roman soldiers for their service in *salt*. Our words *romance* and *romantic* have also a curious history. In the Middle Ages, poems for popular recitation by the troubadours were composed in the vulgar language, which, at that time, was the Romance dialect. These poems were mostly of an imaginative or fabulous character, and by the 16th century a fabulous tale was already called a *Roman*, thus we have *Le Roman de la Rose*. From this signification to that of *work of fiction* was but a step, and we now call some events in real life *romantic*, because they resemble those which generations of novelists have led us to associate with the offspring of their brains.

An amusing example of the diversity of meanings which one word, by analogy and metaphor, may be made to cover is given by Whitney, who says, "Not only an animal has a *head*, but also a pin, a cabbage. A bed has one, where the head of its occupant usually lies—and it has a *foot* for the same reason, besides the four *feet* it stands upon by another figure, and the six *feet* it measures by yet another. More remarkable still, a river has a *head*: its highest point—namely, where it heads among the highlands—and so it has *arms*; or, by another figure, *branches*; or, by another, *feeders*; or, by another, *tributaries*; and it has a right and a left *side*; and it has a *bed*, in which, by an unfortunate mixture of metaphors,

* See "Thought and Language" XI., Knowledge, vol. vii., p. 516.

it *runs* instead of lying still; and then at the farthest extremity from the head we find, not its *foot*, but its *mouth*. Further, an army, a school, a sect, has its *head*. A class has its *head* and its *tail;* and so has a coin, though in quite a different way. A sermon has its *heads*, as divided by their different *headings*, and we can beg to be spared anything more on that *head*. A sore comes to a *head;* and so, by one step further away from literalness, a conspiracy, or other disorder in the State, the *body* politic, does the same. We give a horse his *head*, which he had before our donation; and we treat in the same way our passions—that is to say, if by their overmastering violence we lose our *heads*. And so on, *ad infinitum*.*

Under this all-embracing class of changes by similarity of meaning may be included minor changes which I will call (I.) quantitative and (II.) qualitative changes of meaning. The implication of words may change by enlargement or by diminution. As examples of the former, the Romans called all their emperors Cæsar, and eventually the name was applied to those who could claim relationship to the royal family, the origin of the title dating back to the name of the First Dictator—Caius Julius Cæsar. More recently the Germans have adopted the name in the general signification of *Emperor* (Kaiser), and the same word is apparent in the Russian Czar.

The English word panic is derived from the proper name of the heathen god, Pan, and was formerly used in English in connection with the word fear, *panic-fear* meaning Pan-like fear. In French the word *épicier* is derived from only one of the things the grocer sells—namely, *spice*. Our *anguish*, a word expressive of painful emotion, is derived from the Latin *ango*, to choke, in reference to the well-known physical sensation at the throat which accompanies an excess of grief. From the same root comes also the Latin *angustis*, narrow, referring to the narrowing of the windpipe produced by throttling.

As examples of diminution in the implication of words, the following will suffice:—*Grocer* meant a man who sold things by the *gross;* but the present meaning of the word is far more limited. *Spices*—Latin, *species*—originally meant miscellaneous goods. The modern Greeks use the word *alogon* for *horse;* but this word meant originally any irrational or non-speaking animal.

II. Words improve and deteriorate in signification. Changes for the better are somewhat rare. Such are, *chivalry*, which originally meant simply *horsemanship; loyal*, a good sense grown out of the word legal. *Humble*, originally meaning poor-spirited, is now used to express a desirable frame of mind. *Christian*, now a term of praise, was with Tacitus and Pliny one of opprobrium.

Words change for the worse either by euphemism, the tendency not "to call a spade a spade," so that good words are frequently applied to vile uses, as, "to have a few words" means to quarrel; "to take a drop too much," to get drunk†; or on the principle of "be not wise overmuch." Thus, to be *busy* is good; but to be a *busybody* is not desirable. Goody-goody is used for hypocrite, and the German *selig*, blessed, innocent, comes to be our *silly*.

In such word-changes as these may be found the story of the mental and historical development of the race that effected them. Starting as the mere expressions of sense perceptions, words become by the elastic power of the human mind, and on the principle of similarity, the embodiment of wholly abstract ideas. The word *justice* is derived from a primary idea of *straight*, like *right*, Latin *rectus*. *Wrong* is literally wrong, or twisted from the right or straight path. A *concept* is a taking together. To *imagine* is to make a mental *image* of anything. *Nothing* is *no thing*, like the Latin *nihil*, *ne filum*, no thread, meaning not even the slightest thing. *Angel* is from a Greek word meaning messenger; *spirit*, as I have said, is from a word meaning breathing, whence also our *respire* and other derivatives. The primary sense of *hope* is to stretch or reach forward, and by a similar metaphor we say we *long* for an event. *Religion* is a binding together, *superstition* a standing upon. These few words, taken at random, serve to show how linguistic development may take place by the adaptation of old words to new ideas, and the ignoring of their earlier signification. What is called figurative language, the language of the poets, is guided by the same principle, and it is in this respect that translators generally fail by trying to render the words themselves instead of the ideas they embody. Literal translations are, for this reason, failures. Take, for instance, the phrase in Ecclesiastes rendered by the old Authorised Version, "Vanity of vanities, all is vanity and vexation of spirit." How could any one have the heart to translate it according to the literal meaning of the original Hebrew text: "Smokiest smoke, all is smoke, and badness of breath"? At the present time in a London fog this translation is certainly a striking metaphor, but the former would be generally considered the more poetical rendering of the poet's thought. The figurative nature of language is especially clear in Hebrew. Thus *zaken*, *old*, is literally *bearded*, as with the deaf-mute; *khoshun*, *darkness*, is used to mean *misery*, *adversity; yazad*, to *place* a building, means metaphorically to constitute, establish laws. *Naphesh*, breath, comes to mean vital principle, soul, mind, also life, living thing, animal, body, person, and so on. In every language words serve to express a variety of meanings, and their signification is gathered from the connection in which they appear. So much is this the case that if there is occasion for extreme precision in speech it becomes necessary to define the particular sense in which the chief words are read.

No two persons have precisely the same range of thought or of language, nor do all attach the same meaning to the same words. Words are not perfect models of ideas, but merely signs of them, just as coins are the signs of certain values. The meaning and application of words is frequently misunderstood—thus a young child calls every man *papa*, taking that word to mean a certain group of characteristics which it sees in all. The variations of meaning possible are much greater in some classes of words than in others—smallest in words expressive of mere perceptions, largest in abstract words; but always dependent on the experience and mental tone of the speaker. The same language includes individual varieties, class varieties, and local varieties. No two Englishmen, for example, speak precisely the same language, either in form, extent, or meaning. Still greater variations are found between, for example, a member of the class lawyer and that of agricultural labourer; and locally we branch into dialects, as those of Yorkshire and Somersetshire. Any two English people may talk

* "Life and Growth of Language," Ed. 1879, pp. 86-7.

† Mr. David Christie Murray, in his very interesting novel, 'Rainbow Gold" (Vol. II., p. 232), represents the landlord of a country inn as saying of a customer given to swearing in his cups, "He uses language, which is a thing as I cannot abide. I'll have no man usin' language i' my house." Here, of course, language is used in the sense of *bad* language.

so as to be unintelligible to each other, but all can make themselves understood on subjects of general interest. Each individual does his part to propagate his language, and each generation hands it down by tradition to the next, although in a form somewhat different from that in which it received it: but literature, besides having a powerful influence on the language of individuals, as it were stereotyped that of its authors, and is a conservative element in the ever-changing current of human speech. No individual can affect speech except by setting an example which others follow, for no change in language can take place without the help of the people, and it is thus that each language becomes an index to the average and collective capacity of the community to which it belongs; for a nation developes language only in relation to its needs.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

THE appearance of the first part of a splendid work on "Rotifers," by Dr. Hudson and Mr. Gosse, will excite fresh interest in the study of these wonderful and most fascinating objects for the microscope. The new work is necessarily somewhat costly, but, from the beauty and elaborate character of the coloured plates, it will compare very favourably in point of price with any other first-class monogram.

Every collector of the minute objects of pond life is sure to meet with some typical species of this interesting family, but many are very local; and although, as the preface to the new work states, upwards of ninety species have been discovered since the last edition of Pritchard's "Infusoria" was published, twenty-four years ago, it is by no means probable that even the English list of fresh-water kinds is yet completed.

If the question is asked, "What is a rotifer?" no simple answer can be given, because the characters of different species vary so greatly and so widely that the details common to all are comparatively few, and often difficult to observe. The earliest and best-known member of the family is the *Rotifer vulgaris*, or Common Rotifer, found not only in ponds, but in gutters, tufts of moss, &c., and able to survive and become reanimated after being dried up and passing an indefinite time in mummy-like repose.

The early microscopists were greatly astonished when they saw this creature thrust forth organs which appeared to twirl round on axes, just like watch-wheels. Of course, a little reflection must have led the observer to conclude that this appearance could not exactly conform to reality, but with the imperfect instruments of early date, it must have been very difficult to find out what did actually take place; and at this day, if a common rotifer is shown to any one ignorant of its nature, the motion of its cilia is pretty sure to draw forth the exclamation that a pair of wheels are spinning round.

It is impossible to understand ciliary motion by observing it in a rapid condition, but any of the larger ciliated creatures common in hay infusions enable it to be studied and analysed as they become enfeebled, if a water-drop containing them is permitted to get nearly dry. Each cilium then shows its separate motion, which is found to be much like what can be given to a long elastic stick by a brisk movement of the wrist. It is a wave motion from base to tip, and when a number of cilia move in rhythmical succession they look like wheels, if they are arranged in a circular pattern, and like advancing waves in an elongated one.

It is impossible to state how low down in the scale of living things some rudimentary state of consciousness exists, but when we come to the higher rotifers, many of their actions look as if they were guided by intention for a definite purpose, and on one occasion I saw a fight between a Diglena and an Anguillula. The latter seemed to have offended the rotifer by giving it an accidental flick, to which the rotifer responded by thrusting out its mouth and trying to bite the worm to pieces, in which it partially succeeded. I speak of its "mouth," because in this and some other species the biting organ, commonly called "a gizzard," can act as an external organ with protruding jaws. Generally speaking, the "gizzard" corresponds more or less with the mouth of insects, as Mr. Gosse showed long ago.

Ciliary vibration to bring food-particles within reach of a creature's mouth may be a very simple business. The currents set up in such cases merely have a general tendency to throw floating particles so that a good many cannot help going through the right way, while, perhaps, the majority are hurled far astray. If, however, the proceedings of a common rotifer are noticed, it will be seen that the actions are much more complicated. The so-called wheels can be moved in various directions, and when their whirlpools have entangled small objects of all descriptions, another set of cilia, exerting a selective power, form currents which rapidly take what the creature desires down through the gullet to the so-called gizzard, and thence to the stomach, and reject the rest. When a number of common rotifers, or of other highly-developed free-swimming species, such as the Brachions, are seen near each other in one trough, considerable differences of what would be called skill in more advanced creatures may be frequently noticed, and some might be reckoned much more clever than others in capturing their prey. At any rate, they are more successful, but this may happen merely from their being more lively at that particular time, or more hungry. The free-swimmers have a great advantage over the fixed kinds when their food is at all scarce, and where many are present they often work near each other, as if to gain the benefit of the extensive commotion made by their joint action. This advantage is also gained by the associated colonies of Conochilus.

The student should look specially to the character and shape of the ciliary organ of the rotifer he finds. It varies from a complicated pattern in the Common Rotifer and the *Brachions* (Pilcher Rotifers), to a simple wreath in *Limnias*, and in some species disappears. In the *Floscules*, of which beautiful figures are given in Part I. of the new work, there are no cilia that give an appearance of wheel rotation, but tufts of long hairs which vibrate like the steel notes of a musical-box, without occasioning any strong wave motions. That work is left to less conspicuous organs lower down.

The chances are that hunting in small ponds where plants are growing, in gutters, amongst bits of leaves and *débris*, and especially in duck-ponds, will soon supply the observer with specimens of many characteristic species. The Common Rotifer and the Philodines, which are like her, are good swimmers by means of their so-called wheels, and they can also crawl and hold on to any object by their tail feet. The *Brachions* are free swimmers, and can anchor by means of their tail feet, but they do not crawl. These *Brachions* are the highest of the defensively-armed sorts They are protected by shells more like

plate armour than mail, and the term *loricate* which has been given to them is scarcely appropriate. Those with no such defence have been named *illoricate*. Then come the Tube Dwellers, mostly living in gelatinous vessels like pastrycook's jars; but in the case of *Melicerta* making conical bricks of a yellow colour, and building them up into a pretty tower, widening from the base to the top.

As an aid to the study of Rotifers:—

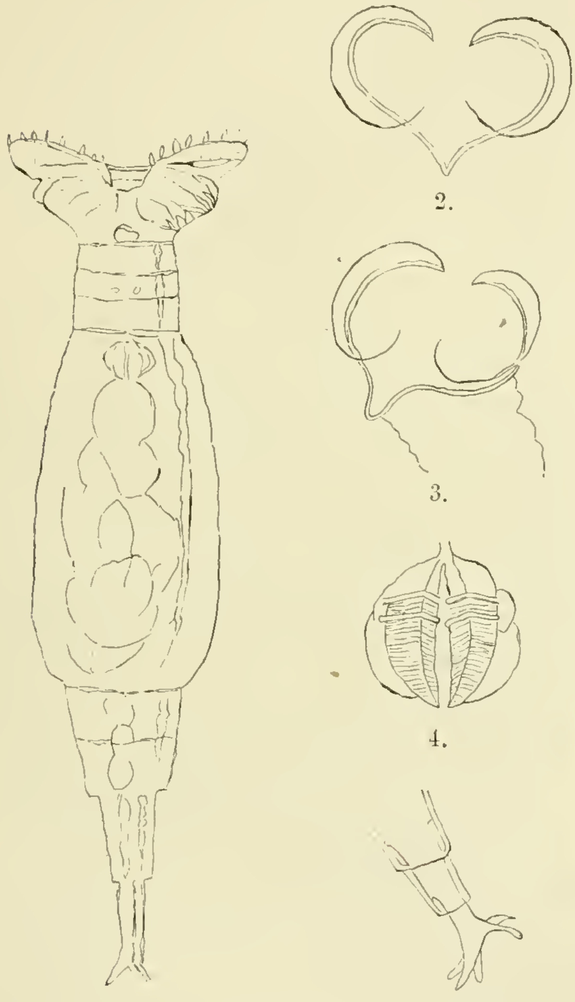


Fig. 1.—*Rotifer citrinus*, yellow Philodim, from Gosse, Tenby.
Figs. 2 and 3. Its Ciliary wreath, vertical and side views.
Fig. 4.—Its Trophi (gizzard).
Fig. 5.—Its Tail foot.

No formal arrangement of rotifers as yet made is satisfactory, but any one of them may help the student to name a species. Dr. Hudson tries his hand at a new distribution. His *Rhizota* are those fixed in their adult stage. *Bdelloida* holds those which both swim and crawl, but they are not sufficiently leech-like to make the name appropriate. Then come *Ploïma*, which he translates as "seaworthy," suggesting, unintentionally, that they are marine. The term indicates *ship* management, and does not well fit. The last group in his scheme is called *Scirtopoda*, not a bad name for those that can skip, but he excludes most that do so, and puts only one remarkable skipper, Pedalion, in this order. It is only fair, however, to Dr. Hudson to note that he points out important correlations between the ciliary organs and the feet of his various orders, and also of their mouth structure. The ciliary organs of these creatures are very difficult to get a thorough notion of. They are usually seen, more or less, in profile, but opportunities should be sought to obtain vertical views, and for this purpose it is often convenient to use a low power and a deep eyepiece, as the greatest penetration results from this plan.

The so-called gizzard is the next organ of importance the observer should study after the ciliary wreath. It varies from complex developments, through various stages to conditions in which its resemblance to the higher forms disappears. One of the most skilful researches in microscopy will be found in papers by Gosse (Philosophical Transactions for February and March, 1855), describing and figuring no less than eighty-five distinct sets of manducatory (chewing) organs of Rotifers. Some remarks on these organs will be made in a succeeding paper. They should be studied in action, and also when freed from muscular and other matter by a drop of potash solution, which dissolves it away, and leaves the hard, glassy material, probably a form of chitin, quite clear. The *Liquor potassæ* of the chemists' shops, diluted with four or five times its bulk of water, answers the purpose.

Recurring to the new work, it should be known that Mr. Gosse and Dr. Hudson have each for many years been collectors and observers of Rotifers, and between them are able to offer a more perfect monogram than any single authority could have supplied. Mr. Gosse's skill in making beautiful and accurate drawings is too well-known to need mention, and Dr. Hudson has won distinction in the same line. Their joint labours result in a truly splendid work.

STORY OF THE MOON.*

THERE are few points in modern scientific inquiry more important or more interesting than the application of each newly recognised truth to all the varied matters on which it bears. The most striking example of this process may be found in the application of spectroscopic analysis to the heavenly bodies; only in this case it chanced that though spectroscopic analysis is in reality an optical method of pursuing chemical inquiries, it was originally (counting from the detection of the dark lines in the spectrum) suggested by astronomical research. Men inquired into the meaning of the dark lines in the solar spectrum long before they had any idea that in the spectral analysis of light they had a most effective method of chemical research. It seemed natural enough, then, in that case, to apply the principles discovered in the laboratory to the work of the astronomer in the observatory. But with many discoveries made in special lines of research this has not been the case. The workers in one field have been too busily employed to note either on the one hand the value of their results for other fields than their own, or on the other, the advantage they might obtain from employing in their own field other workers' results. In this way many important discoveries have been missed or delayed. Hence the necessity, which Spencer and others have pointed out, for scientific overseers, who, not working specially in any field, but having a general knowledge of what is going on in all,

* "The Moon: considered as a Planet, a World, and a Satellite." By James Nasmyth, C.E., and James Carpenter. (Murray: London.)

B

may note what the workers themselves would be apt to overlook,—the general rather than the special significance of the results obtained in the various fields of scientific labour.

In two directions results have been obtained which enable us to examine with advantage the perplexing problems presented by the surface of our neighbour planet, the moon. On the one hand, astronomical observations on bodies of a very different class—the stars—have corrected the old idea that the various orbs peopling space are probably formed of very different materials. Dr. Whewell was perhaps the last to maintain this doctrine (in his "Plurality of Worlds"), though we still occasionally hear a form of the doctrine advanced in the utterly untenable theory that in the solar system the outer planets are formed of the lighter elements, the inner planets of the heavier,—a theory inconsistent with physical and dynamical possibilities. We now see that in all probability all the orbs in space are aggregations of matter in which the various elements though not present in precisely the same proportions, are yet not very diversely represented. This doctrine applied to the moon at once defines the general nature of the problems we have to deal with, and suggests the line on which their interpretation must be sought. On the other hand, geologists have recognised the fallacies underlying their old ideas respecting the formation of the various features of the earth's surface-contour.

They no longer regard mountain ranges as portions of matter thrust upwards by the earth's interior forces, or these interior forces as products of the interior fires of the earth. On the contrary, they regard the great mountains of the earth as among the products of the exterior forces, the action of sea, rain, wind, snow, and so forth,—as resulting from processes of deposition in long, trough-like hollows, the deposited masses being eventually raised by side pressures. Again, they no longer regard moutain ranges as the oldest but rather as among the very youngest features of the earth's crust, the loftier mountains being younger generally than those of less elevation, while some of the smaller hills in certain regions are actually the wrecks of forms of elevation of which (at any rate on their old scale) no examples now remain upon the earth. Here, again, are changes of view which alter entirely the character of the problems presented by the moon's peculiarities of surface-contour, and may also serve to direct us to the proper lines of thought for their solution, as well as to new methods of observation for obtaining fresh evidence in regard to our companion planet.

We should have been glad if Mr. Nasmyth, in issuing a new and cheaper edition of his valuable work on the moon, had taken the opportunity of reviewing the somewhat crude theories of the moon's volcanic history which are associated in this volume with the finest illustrations of lunar features—craters and mountain-ranges, peaks, ravines, and valleys—ever produced. His work in this third edition is indeed as valuable as ever: but it might have been made much more valuable, if recent researches and recent results had been brought to bear upon its theoretical portions. These do not need discussion, now, however; having already been duly weighed. They are a little more out of date now than they were when the first edition appeared, but not more obviously inconsistent with the views of to-day than with those already attained twelve years ago. Apparently there has been no attempt at revision even in points of detail. For we are still told that Schmidt's map of the moon cannot probably be produced, though it has now been several years in astronomers' hands; and many little points of the same kind show that the present issue is only in the publisher's sense "a new edition."*

That the moon is or rather has been a planet there can be very little doubt, though whether she was ever a planet like our earth may be reasonably questioned. She is now so utterly unlike the earth that it becomes rather difficult to imagine that there was ever even such general resemblance as is implied in the remark that she was once a planet. She is not only arid and airless, but even were she clothed with sea and air she would yet be utterly unlike the earth because of her long day of more than four weeks. We know, however, that that is a result of terrestrial influence, and that in the fulness of time our earth must undergo a similar change. Indeed this peculiarity, telling us as it does of the immense age of the moon, enables us more readily to understand her deathlike surface. It shows us that the moon has existed long enough as a planet to have aged and died, even as we see she has.

There is no difficulty, now, in understanding that even if formed as long ago, or later, the moon would have been much older than the earth. With 81 times as much mass and only $13\frac{1}{2}$ times as large a surface, our earth would have cooled through the various stages of her life much more slowly,—in fact each stage would have lasted just as much longer as 81 exceeds $13\frac{1}{2}$, or be six times as long. Suppose the earth and moon both white-hot 60 millions of years ago, then the moon would have reached the earth's present stage 50 millions of years ago, corresponding to 300 millions of years of earth-life,—so that the moon would tell us of the earth's condition 300,000,000 years hence. And though this result is based on assumptions, it yet presents truly the general inference we may safely form that the earth will not be in the same stage of planetary life as the moon until many millions of years have passed. (If each stage of the earth's life is six times as long as the corresponding stage of the moon's, then—on any assumption whatever—the earth will only reach the moon's condition after a period five times as long as the interval which has elapsed since they were both simultaneously in the same stage, or running neck and neck in the race of planetary life.)

But even with this knowledge it remains difficult to understand why the moon should be so unlike the earth. The waters of the earth may soak their way beneath the crust (as our underground caves, and even our hot wells and volcanic outbursts, show they are doing) till they all disappear. Our air can hardly, however, become thinned to the condition of the lunar air. And even if it did, and every trace of water had vanished, the earth would not be as the moon is. There are no great craters on the earth as on the moon: there are scarcely any great mountain ranges on the moon as on the earth. In these chiefly, but in other important respects also, the moon

* Even the description of spectroscopic analysis as a method which has been brought into use "during the past few years" reads strangely in a work dated more than a quarter of a century later than the discovery by which that method was introduced, and twenty-two years later than the most recent of the spectroscopic discoveries mentioned in the book. Errors too which were noted when the first edition appeared might as well have been corrected. Amongst slight faults, more significant perhaps than important errors (which may be errors of opinion, and still maintained) we note the reproduction of a curiously absurd mistranslation of Laplace's remark that he advanced his famous nebular hypothesis "with the mistrust which everything that is not a result of observation and calculation should inspire:" this is translated as if Laplace had written *qui doit inspirer* (instead of *que doit inspirer*), "the mistrust which should inspire everything," &c.

and the earth are so unlike that the uniformitarian theory seems to fail.

But so soon as we apply to the moon the two lines of reasoning which were touched on above, we at once find reason for expecting just such differences as actually exist. Made of the same materials, proportioned probably in much the same way, the moon and the earth would have very different histories. To begin with, as we have just seen, the stages of the moon's life would be very much shorter than those of the lifetime of our earth, and therefore, even under the same conditions, the power of producing great changes of contour would be far less in the moon's case. But the conditions would not be the same. With 81 times as much matter, and presumably about 81 times as much water—spread over a surface only $13\frac{1}{2}$ times as large—the earth would have had six times as much water per square mile as the moon: this would have made a great difference in the efficiency of all those forms of denuding action (and they are altogether the most important) which depend on the action of water in its various forms: it would also have greatly increased the duration of the action of these forces upon the earth, as compared with that of the action of the similar but much feebler forces on the moon. But an even more remarkable difference appears in regard to the probable density of the lunar air when she was passing through that stage of her life which corresponded with the present state of our earth's life. For, while precisely the same reasoning would apply to the air, so that the quantity over each square mile of the moon would probably have been but one-sixth of the quantity over each square mile of the earth, that smaller quantity would have been compressed only by the small force of lunar gravity, about one-sixth of terrestrial gravity. Thus the density of the lunar air would have been but one-thirty-sixth of the density of the air we breathe. Air so tenuous as this would not only be unfit to support life, it would have had very small efficiency as a denuding agent, whether we consider its direct action, or its power in conjunction with water.

On the whole, subaërial denudation on the moon must in all probability have been so exceedingly slow in its action, and the time during which it acted so exceedingly short, that the wonder is how any denudation at all can have taken place on the moon's surface. We may probably ascribe such denudation as is indicated by the condition of the crater-covered regions, and by the aspect of the mountain ranges—indeed by the very existence of any mountain ranges at all—to the time when the lunar atmosphere, like the earth's air in past ages, was laden with carbonic acid (carbon dioxide), sulphurous acid, sulphuretted hydrogen, boracic acid, and so forth. The earth's air when so constituted was immensely more dense than it is at present, and all the processes of denudation went on far more rapidly than they have done since. The lunar atmosphere at that stage of the moon's history was probably about as dense as our own atmosphere is now; but even if less dense, its constitution and its high temperature in connection with the high temperature of the crust, would lead to changes at least as rapid and effective (while they lasted) as those which have taken place on the earth since the earliest ages of which geological records remain.

Thus we should not expect to find the great craters belonging to the early stages of the moon's vulcanian history converted into such wrecks as alone attest on this earth the former existence of similar terrestrial crater-mountains. But we may yet fairly look for evidence of considerable denudation during the time, short-lasting though it may have been, when the moon's atmosphere and oceans were capable of doing effective denuding work. Accordingly we find that while the immense craters remain still the most striking features of the moon's surface, they attest the action of subaërial denudation during a period which, though it may have been short compared with the corresponding period of our earth's history, must still be measured by hundreds of thousands of years.

Now the great craters, grand though their remains are compared with the mere wrecks which (as in Mull and Skye) remain to show on our earth how large terrestrial craters once were, show yet signs of denudation. And we see in lunar mountain ranges the products of such denuding work. The great range called the Lunar Apennines attests, for example, on the moon the long-continued action of denuding forces by which the whole tract now occupied by the Sea of Serenity and the Sea of Showers was covered with matter worn by the action of sea and storm, river, rain, snow, and wind, from the surface of the lunar continents around. In a vast trough-like depression running athwart what was once the floor of an immense sea (covering both the great regions just named) the products of denudation were deposited in greater quantity than on either side. Then as the region thus heavily laden with deposited matter sank more and more deeply, the matter was collected (to the depth of many miles) out of which the future mountain range was to be formed. When at length this process ceased, and the shrinking of the moon's crust compelled this seam of sedimentary deposit to rise, forced upwards by side pressure, the range of mountains rose, rounded and dome-shaped then, but presently to be wrought into the precipitous pinnacled forms now recognised in the Lunar Apennines. The side pressures no doubt generated enormous heat, converting the sedimentary strata into various kinds of crystalline rock, the harder materials resisting best the still active denuding forces of the lunar atmosphere, and forming the higher peaks of the range as we know it now.

But we see in the evidence of such denuding action, the last important traces of subaërial denudation in the moon. Not there as on this earth have lands and seas interchanged after the manner described by Tennyson when he says—

> There rolls the deep where grew the tree;
> Oh earth what changes hast thou seen!
> There where the loud street roars, hath been
> The stillness of the central sea.
> The hills are shadows, and they flow
> From form to form, and nothing stands,
> Like mists they melt, the solid lands,
> Like clouds they shape themselves and go.

One interchange of land and water, and one only, can be recognised on the moon. The floors of the great seas tell of buried continents. The very shapes of sand-covered craters, as large as any now remaining uncovered, can be recognised—shadowy and ghost-like, but still clearly recognisable—in the broad dark tracks called seas, which doubtless are the floors of what were once great lunar oceans.

Thus do the most characteristic features of the moon's surface (except the immense ray-systems which belong to an earlier stage yet) find satisfactory interpretation in the comparative shortness of the stages of the moon's volcanian history. There are many great craters because there was not time or power to wear them down. There are few great mountain ranges because there was not time or power to fashion many. But *some* work was done in

this way; and the broad, dark sea-floors attest the energy with which for awhile such work went on, while the ghosts of craters buried beneath the sands of those lunar seas show that once, if no more, sea replaced land even in the moon.

SOAP-BUBBLES AND FILMS.*

By T. O'Conor Sloane, Ph.D.

THE true nature of a liquid film is comparable to that of a perfectly elastic and tightly-stretched membrane. All liquids are bounded and enclosed by such a membrane, composed of the substance of the liquid itself. The phenomena of films, under the form of soap-bubbles, have been known for many generations. They were seriously studied by Sir Isaac Newton, and later by the scientist Dr. Plateau, of Belgium, a curious study for one, like the latter, afflicted with total blindness.

If a ring one or two inches in diameter, and provided with a handle, is dipped into a solution adapted for forming films, and is withdrawn, it will be found to be filled with a beautiful film, straight and firm, reminding

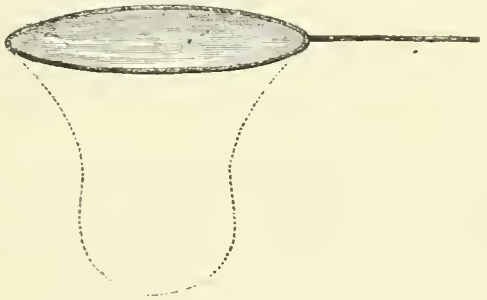


Fig. 1.

us of the wing of a dragon-fly (Fig. 1). If we blow against it, it will be driven out into a purse-like shape of very characteristic outline (see dotted line). If it be held between the mouth and a candle, it will screen the latter from strong blowing until it breaks, when the candle will be extinguished.

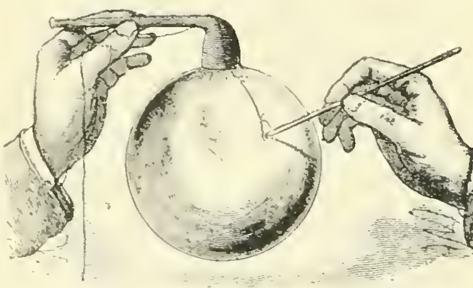


Fig. 2.

By particular management a hole of any desired size can be made in the side of a soap bubble. This is done by tying a small loop, less than the third of an inch, in the end of a silk thread, moistening it thoroughly with the solution, and hanging it over the bowl of a pipe just before blowing a bubble. As the bubble is blown, the end of the thread and the loop will adhere to it. Then by touching the film within the loop, either with a hot wire or with a piece of blotting-paper, the film will break inside of the loop, which will fly open to its widest extent (Fig. 2). The bubble will immediately collapse, or by vigorous blowing may just be kept inflated. The blast from the hole is sometimes enough to extinguish a candle.

This shows that the film is elastic. To measure directly the tension exerted by an inflated bubble, a glass tube bent at a right angle may be attached to the end of a pipe-stem. After blowing a bubble, the end of the glass

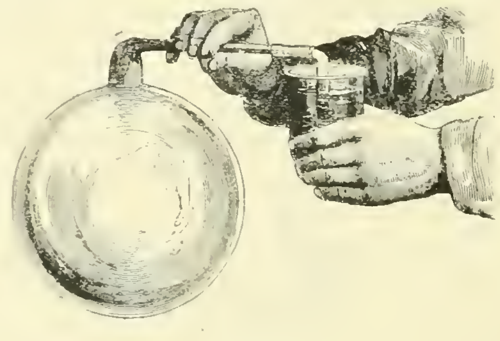


Fig. 3.

tube may be dipped into water, when the depression will show the pressure (Fig. 3). It will be but a small fraction of an inch.

To measure the tension of the film per unit of surface, a little frame with grooved sides is employed. In the grooves a wire carrying a little scale pan slides freely

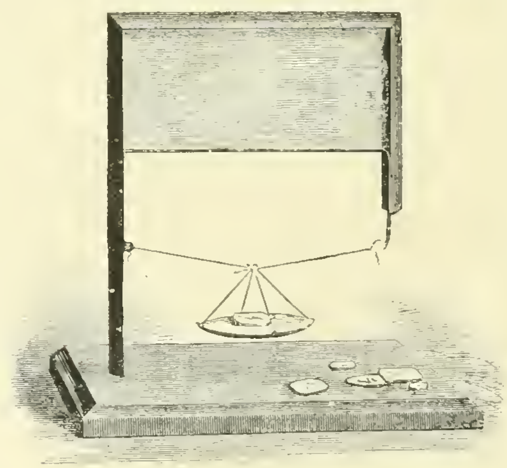


Fig. 4.

up and down (Fig. 4). The wire is pushed home to the top of the frame and some of the solution introduced, either by dipping the top or by painting it in with a brush. Then, by adding weights, the film can be pulled down like a delicate curtain until the limit is reached, and it breaks.

By mounting a ring as a pendulum and filling it with a film (Fig. 5) the retardation the latter exercises on its swing is quite striking.

Four of the rings may be mounted as a windmill (Fig. 6), and be made to turn several times by the breath until their perishable sails break one by one.

If a thread, well moistened with the solution, is laid

* From a lecture on "The Physics of Tenuity," given in full, with many additional illustrations, experiments, and formulas, n Supplement to *Scientific American*.

across a ring containing a film, and the film is broken on one side of it, the thread will be suddenly snatched across the ring and be drawn up tightly against the

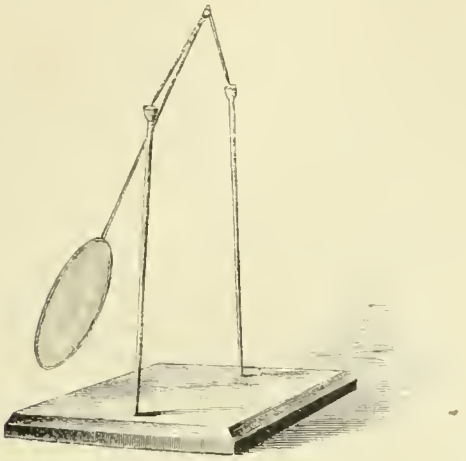


Fig. 5.

opposite side. To facilitate manipulation, the ends of the thread may be fastened to the ends of a wire, or

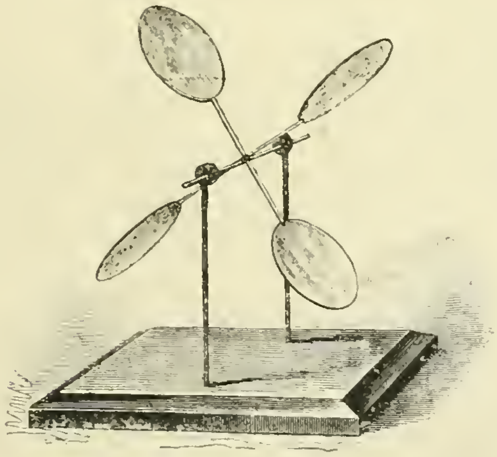


Fig. 6.

thin slip of wood. On drawing out the thread it will draw with it a curtain of film, and will assume the

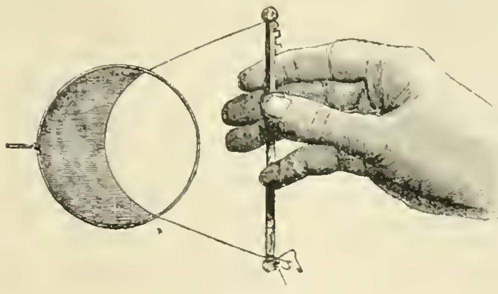


Fig. 7.

curve of the arc of a circle (Fig. 7). In this way the ring may be again filled with film and the thread be entirely removed.

A bubble may be blown, a moistened ring applied to it, and the pipe pulled away, leaving the bubble adhering to the ring. The pipe may be again dipped, passed through the upper part of the bubble into its interior, and a second bubble may be blown thus in the interior of the first (Fig. 8).

Fig. 8.

By catching a bubble on a ring, as described above, and touching it with a second ring, previously moistened, it will adhere to both, so that it can be drawn out into

Fig. 9.

the most elegant shapes (Fig. 9), reminding us of the iridescent glass vases so popular a few years ago.

Again attaching a bubble to a ring, the air in it can be drawn out by inverting the mouth of the pipe until,

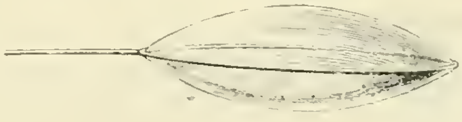


Fig. 10.

on pulling away the pipe, a lenticular bubble will remain (Fig. 10).

The well-known diffusion experiment with a porous jar can be very nicely shown with a film. The mouth of

the jar, a porous cup of a Bunsen or Daniell battery, is dipped into the solution. A glass vessel full of hydrogen,

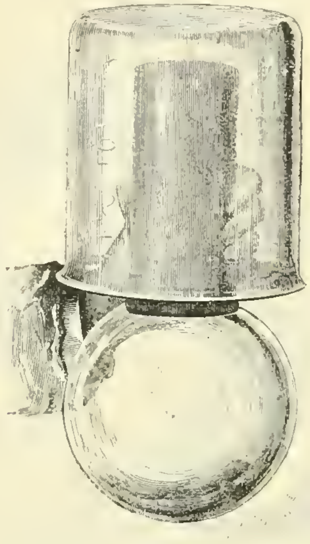


Fig. 11.

or street gas, is inverted over it (Fig. 11). The lighter gas diffusing into the porous vessel blows a bubble from the film. On removing the outer jar the reverse action takes place, and the bubble collapses.

Very pretty effects can be produced by blowing bubbles full of tobacco-smoke. By attaching the pipe stem by a rubber tube to the gas fixture, they may be inflated with gas, when they will rise like balloons. Many formulas have been published for making a good mixture. Plateau's mixture is thus prepared: one part of Marseilles soap is dissolved in forty parts of water at a moderate heat. It is filtered through very porous filter-paper after cooling, and fifteen parts of the solution are mixed with eleven of Price's glycerine. The mixture is thoroughly shaken, and is allowed to stand for seven days in a room that is not too cold (over 67° Fahr.). On the eighth day it is cooled for six hours to a temperature of 37° Fahr., and filtered. A bottle of ice should be kept in the funnel. The first portions may need refiltering. Very porous paper must be used. Halbrook's brown oil silk soap or his Gallipoli soap and Scheering and Glatz's glycerine work very well. The second filtration may be omitted, long standing and decantation from the sediment being used. After all the trouble the mixture may not give very good results.

To succeed in these experiments a little practice and niceness of manipulation are required, together with a good soap solution.

INDIAN DEATH CUSTOMS.

By STELLA OCCIDENS.

THE primitive manners and customs of the North American Indians are fast passing away, and among these, their quaint mortuary customs. This is a subject full of interest, since every nation has its own peculiar methods with regard to burial ceremonies. In a few years all trace of these will be lost, for fast-spreading civilisation will soon make these customs a matter of ancient history.

Among the North American Indian tribes, there are seven modes of burial, viz., by *inhumation*; by *embalmment*; by *deposition* of remains in urns; by surface burial (the remains being placed in hollow trees or logs, pens, or simply covered with earth, or bark, or rocks forming cairns); by *cremation*; by *aerial sepulture* (the bodies being left in lodges, houses, cabins, tents, deposited on scaffolds or trees, in boxes or canoes, supported on scaffolds or posts, or placed on the ground), and by *aquatic* burial beneath the water, or in canoes turned adrift, each tribe follows its own course, according to the established custom. The first form of burial, that is, of interment in the ground, was customary among the Mohawks of New York. Schoolcraft in his history of the Indian tribes tells us that "the Mohawks of New York made a large round hole in which the body was placed upright, or upon its haunches, after which it was covered with timber, to support the earth which they lay over, and thereby kept the body from being pressed. They then raised the earth in a round hill over it. They always dressed the corpse in all its finery, and put wampum and other things into the grave with it: and the relations suffered not grass nor any weed to grow upon the grave, and frequently visited it and made lamentation." *

The same custom prevailed among the Indians formerly inhabiting the Carolinas, but they placed the corpse in a coffin made of woven reeds or hollow canes, tied fast at both ends. After a time the body is taken up, the bones cleaned and deposited in an ossuary, called the Quiogozon.†

The Creeks and Seminoles of Florida made the graves of their dead as follows:—

"When one of the family dies the relatives bury the corpse about four feet deep in a round hole, directly under the cabin or rock where he died. The corpse is placed in the hole in a sitting posture, with a blanket wrapped about it, and the legs bent under and tied together. If a warrior, he is painted, and his pipe, ornaments, and warlike appendages are deposited with him. The grave is then covered with canes tied to a hoop round the top of the hole, then a firm layer of clay, sufficient to support the weight of a man. The relations howl loudly and mourn publicly for four days. If the deceased has been a man of eminent character, the family immediately remove from the house in which he is buried, and erect a new one, with a belief that where the bones of their dead are deposited the place is always attended by goblins and chimeras dire."‡

The custom of tying up the corpse likewise prevails among the Yumanas of South America, who "bury their dead bent double, with faces looking toward the heavenly region of the sunrise, the home of their great good deity, who they trust will take their souls with him to his dwelling. On the other hand, the Peruvian custom was to place the dead huddled up in a sitting posture, and with face turned to the west."§ With regard to burying in the ground, Tylor informs us that it is customary among the Winnebagos of North America to bury a man "sitting up to the breast in a hole in the ground, looking westward; or graves are dug east and west, and the bodies laid in them with the head eastward, with the motive that they may look towards the happy land in the west."‖

* Hist. Ind. Tribes of U.S., 1853, Pt. III., p. 193.
† First annual report of Bureau of Ethnology, 1879-80, p. 94, Smithsonian Institution.
‡ Schoolcraft, "Hist. Ind. Tribes of U.S.," 1855, Pt. V., p. 270.
§ Tylor, "Primitive Culture," vol. ii., p. 423.
‖ Ibid., p. 422, vol. ii.

Among the Otoe and Missouri tribes of Indians located in Gage county, Nebraska, it is usual to prepare the burial costume before the man for whom it is being prepared is quite dead. He is dressed in his finest clothes and ornaments, according to his own taste and directions. He tells his friends whether he wishes to have the customary sacrifices offered at his funeral or not, and they observe his commands implicitly. After he has given all his directions the women cut away part of his hair close to the scalp. The funeral shroud is composed generally of the most expensive blankets, ribbons, and beadwork. When the corpse is dressed it is placed in a recumbent position in view of all the relatives, who keep up a continual series of piercing screams and loud lamentations, expressing a grief which shows the intensity of Indian devotion and attachment. When all is in readiness, the aged men arranged in a circle round one of their number, chant a peculiar funeral dirge, keeping time upon a drum or some cooking utensil. Now and then an aged relative will get more excited than the rest, dancing excitedly, vociferating with wild gestures, tomahawk in hand, and imprecating the evil spirit, which he endeavours to drive away to the land where the sun goes down. The evil spirit being thus effectually banished, the mourning gradually subsides, blending into scenes of feasting and refreshment. The burial feast is in every respect equal in richness to its accompanying ceremonies. "All who assemble are provided with cooked venison, hog, buffalo, or beef, regular waiters distributing hot cakes soaked in grease and coffee or water as the case may be." After the feasting is over the corpse is placed in a waggon and propped up in a sitting position, with friends on each side; or else it is bound on a horse, and "thus conveyed to its last resting-place among his friends." In this same waggon all the goods and chattels of the deceased are placed, which are unloaded at the burial place, and arranged in the vault-like tomb, after which the corpse is laid in the grave. "The bottom which is wider than the top (graves here being dug like an inverted funnel), is spread with straw or grass matting, woven generally by the Indian women of the tribe, or some near neighbour. The sides are then carefully hung with handsome shawls or blankets, and trunks, with domestic articles, pottery, &c., of less importance, are generally piled around in abundance. The sacrifices are next inaugurated. A pony, first designated by the dying Indian, is led aside and strangled by men hanging to either end of a rope. Sometimes, but not always, a dog is likewise strangled, the heads of both animals being subsequently laid upon the Indian's grave. The body, which is now placed in a plain coffin, is lowered into the grave, and if a coffin is used the friends take their parting look at the deceased before closing it at the grave. After lowering a saddle, bridle, blankets, dishes, &c., the mourning ceases and the Indians prepare to close the grave." Among the Otoe and Missouri Indians dirt is not thrown in upon the body, but simply rounded up from the surface upon stout logs that are accurately fitted over the opening of the grave. After the funeral ceremony is completed all the property of the deceased, from a tent and horses to the merest trifle, are distributed among the relatives, whilst wife, children, or father are left without anything. A midnight vigil is carefully kept by these Indians four days and nights at the graves of their departed. "A small fire is kindled for the purpose near the grave at sunset, where the nearest relatives convene and maintain a continuous lamentation till the morning dawns. There was an ancient tradition that at the expiration of this time the Indian arose, and mounting his spirit-pony, galloped off to the happy hunting-ground beyond."*

Formerly, when a Greenlander died his property was regarded as having no owner, unless he had grown-up children, and every one took what he could get, whilst the wretched widow or children were left out-door pensioners. In Vanua Levu, one of the Fiji Islands, a chief's death "is the signal for plunder, the nearest relations rushing to the house to appropriate all they can seize belonging to those who lived there with the deceased."†

(To be continued.)

WASPS AND HORNTAILS.

By E. A. Butler.

Of our seven British species of *Vespa*, the hornet stands by itself, both as regards size and colour, and may be conveniently left till we have considered the remaining six, which are more or less alike, and consist of three that form their nests underground and three that build in trees. The latter are *V. sylvestris*, *arborea*, and *norvegica*. The second of these we need not trouble ourselves about, as it is a rare insect, and not at all likely to be met with. *Norvegica* occurs principally in the north of our island, being fairly common in Scotland; and *sylvestris*, while generally distributed, is yet not so common as the ground builders.

The latter are *V. vulgaris*, the so-called "common wasp" (not that it is always the commonest, though often so), *germanica*, and *rufa*, and it is the two former of these that are most likely to fly in at our open windows and manifest a disposition to join us in our meals. On one occasion a large number of females of *germanica* were found gregariously hibernating in an upper room of a large building that was used for storing furniture. Some were amongst some blankets used in covering the furniture, and others were clinging to some rough woodwork, into which, as with a consciousness that their limbs would become benumbed and useless during the winter, they had firmly dug their mandibles. To give an idea of the proportionate distribution of these species, I may mention that a friend of mine in the south of England, last summer, on examining sixty wasps that had been captured quite promiscuously in his garden, found them to consist of twenty-four *germanica*, fourteen *vulgaris*, seventeen *rufa*, and five *sylvestris*. This, however, probably represents an unusually large proportion of *rufa*.

For the distinctions of these six yellow and black species, we must look mainly at the face and the first segment of the abdomen. Turning first to the former of these, we examine carefully the central plate referred to in our last paper—viz., the clypeus—and are at once struck by differences here; in all the clypeus itself is yellow, but the black markings upon it vary (Fig. 1). *Vulgaris* and *rufa* carry on the clypeus a vertical black stripe, descending, in the workers, from the centre of its upper

* Account given by Dr. W. C. Boteler, physician to the Otoe Indian agency, Gage county, Nebraska, published in first annual report, Bureau of Ethnology, p. 96, Smithsonian Institution.

† Sir J. Lubbock, "Origin of Civilisation," p. 447.

edge to the centre of the lower, and more or less dilated near the lower extremity into two lateral projections; in the males and females, the mark usually does not quite reach the lower margin of the clypeus, but terminates at these projections, and it thus acquires something of the appearance of a cheese-cutter with a long and stout handle. It has also been likened, with less justice, to an anchor, and hence both these species are sometimes called anchor-faced wasps. *Norvegica* also carries the anchor-mark on its clypeus; so that there are three species adorned in this way, two ground-wasps and one arboreal species.

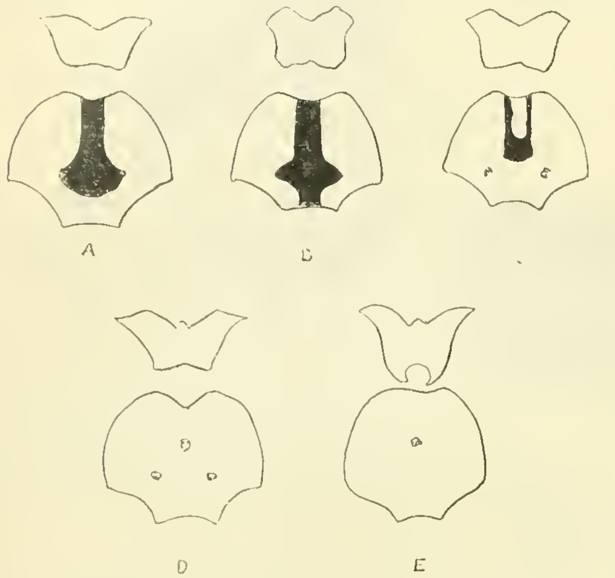


Fig. 1.—Coronet-spots and clypei of wasps. A, *V. vulgaris*, female; B, *vulgaris*, worker; C, *germanica*, worker; D, *germanica*, female; E, *sylvestris*, worker.

Germanica, on the other hand, carries, in the workers, a central black stripe, stretching only part of the way down the clypeus, and often more or less imperfect, and two black dots placed triangularly with the free end of the stripe. In the males and females, there are usually simply three black dots placed triangularly, without a black stripe at all. Lastly, *sylvestris* has only a single black dot in the centre of the clypeus, or, in the females, often no black markings at all.

Turning now to the basal segment of the abdomen, we find that *rufa* has some rusty stains around the black spots there, in addition to the yellow band which occupies the greater part of the segment, and the same rusty hue often occurs on other segments as well; it is from this peculiarity that the species derives its name (*rufa* = red). But it would not be safe to conclude that any anchor-faced, red spotted wasp is *rufa*, since *norvegica* is usually similarly coloured; the red colour, however, will serve to distinguish *rufa* from *vulgaris*, both of which, it will be remembered, are anchor-faced.

The basal segment of *germanica* carries three large and distinct black spots in its yellow band, the centre one of which is diamond-shaped; *vulgaris*, instead of this diamond, has simply an angular indentation. But these two species are sometimes very difficult to separate, especially the workers, since the markings on the abdomen vary a good deal, and even those on the face are not quite constant. *Sylvestris* is sufficiently separated from the rest by its single clypeal spot.

We still need a reliable means of separating *norvegica* from *rufa*; this is to be found in the compound eyes, which, in the latter species, are continued to the base of the jaws, but in the former do not extend so far. *Sylvestris* agrees with *norvegica* in this respect. We may add to these distinctions, that while the ground-wasps have a yellow stripe on the scape of the antennæ only in the males, the tree-wasps have it in all sexes. As if, however, to prevent the use of this as a reliable diagnostic character, the female of *rufa* sometimes takes on a yellow stripe. The coronet-shaped spot, too, varies in the different species, but not in such a way as to be rendered easily intelligible in words, and the above distinctions will, in most cases, suffice for the determination of the species.

Few people seem to be familiar with the hornet, except by name, and two totally different insects are commonly mistaken for it. One of these is a large Dipterous, or two-winged, insect, the largest *fly* we have in this country. It is a robust, black and yellow creature, called *Asilus crabroniformis*, the specific name, which means "hornet-like," being given in allusion to the above error, *crabro* being the Latin name for a hornet. It is a common insect in the summer time in many places (not indoors, however), and dashes about with bold and vigorous flight and great buzzing, and with so martial an air that it is not surprising that those who do not know its real nature should be intimidated by it. It is, however, a perfectly harmless creature.

The other insect sometimes mistaken for a hornet comes a little nearer the mark, for it *is* hymenopterous; but still it does not belong to that section of the order which contains the wasps and other stinging insects. It is closely related to the group of saw-flies, and is one of the largest hymenopterous insects we possess. It is a yellow and black powerfully-flying creature called *Sirex gigas* (the specific name is given in allusion to its *gigantic* size), and the female, which is the sex most often seen, possesses a long and stout ovipositor, which looks dangerous enough, though it is simply a kind of auger, and not a poisonous weapon at all, so that the insect, though so formidable in appearance, is in reality harmless. This great ovipositor has acquired for its possessor the name of "Horn-tail."

Both the above insects are yellow and *black*, and, as we have already seen, the latter colour forms no part of the ornamentation of a hornet; moreover, when one comes to look at them closely, they are at once seen to be altogether unlike wasps, though, of course, when they are on the wing, and dashing rapidly about, it is not so easy to see this. Now the hornet, the scientific name for which is *Vespa crabo*—*i.e.*, reversing the order of the words, the "hornet wasp,"—is in shape exactly like an overgrown wasp; so that its form must be familiar to every one. We have only to imagine the yellow of the wasp's body to be deepened in tone, the black to be replaced by brown, and the whole insect to be considerably magnified, and the wasp becomes a hornet. If this be borne in mind, there should be no difficulty whatever in recognising a hornet, for there is no other British insect to which the description will apply. Since the *Sirex* is not unfrequently found in houses, as well as the hornet, it is all the more necessary to be able to distinguish the harmless insect from the dangerous one. The hornet's wings, like those of a wasp, are covered with a profusion of tiny hairs, which, however, are so small as to be quite invisible without the aid of a microscope.

The hornet constructs its nest of a material prepared similarly to that used by the rest of the genus, but it is

of a coarser texture, and inclines to a yellowish brown, instead of the delicate grey of the smaller species. As an instance of the rapidity with which these insects work, the following particulars, given by Mr. R. S. Standen, concerning a hornet's nest found, in the summer of 1881, in a shed in Norfolk, may be quoted. It was constructed in a thin shell of mortar about the size of a lemon, and open at one end. It was commenced on June 24, and the writer goes on to say:—"Although when I first observed her (the queen hornet), the shell was perfectly empty, by the morning of the 28th—less than five days—she had constructed twenty-six cells; two were empty, seventeen contained eggs, five had good-sized larvæ, and the remaining two were already sealed up for the pupa stage." Prudential considerations at this moment suggested the advisability of putting a stop to the further development of this interesting colony, lest battle might have to be done against scores of winged warriors, instead of one solitary heroine; and the whole colony, together with its foundress, were accordingly massacred. Many other instances are on record of the occurrence of hornets' nests in sheds, lofts, and thatched roofs.

The *Sirex* mentioned above may now come in for a somewhat more detailed notice. It occasionally occurs in houses in the same way as the large longicorn beetles referred to in a previous paper; it is a wood-borer, and attacks fir-wood chiefly, and its larvæ and pupæ are therefore sometimes present in the timber used in the construction of houses; and, enclosed in this, the immature insect may be introduced into the edifice, the completion of its metamorphosis being delayed till after the timber has been placed in position, when it emerges, to find itself, not amidst its native pines, but an uninvited guest in society to which, on account of its size, its appearance, and its loud buzzing, it is often an object of unnecessary terror. Sometimes it does not issue from the wood for a considerable time, which may occasionally amount to years; amongst other instances, there is a record of the emergence of several specimens from the floor of a nursery in a house that had been built for three years, and where, very naturally, they caused quite a fright to the children who were its occupants. Usually they occur in houses either singly, or at most in twos or threes, but sometimes considerable numbers have been met with; for instance, in the summer of 1878, no less than a dozen specimens were captured in an ironmonger's shop in Chichester. It is obvious that in many cases these household specimens may not really be British at all, but, if the timber be foreign, may have been imported with it.

The female of *Sirex gigas* (Fig. 2) has a black head and thorax, and a long cylindrical yellow abdomen, with a broad black band, like a mourning band, across the middle. Behind the eyes, which are not situated on the bend of the head, as they are in wasps, are also two yellow patches, which are so conspicuous and shining, that they might very probably at first sight be mistaken for the eyes themselves. The antennæ and legs are long and yellow, and the former are proportionately much longer than in the wasps, since they consist usually of about twice as many joints. The four large membranous wings are shining and transparent, though strongly tinged with yellow, and are without the minute hairs that cover those of wasps. When the wings are fully spread, the insect may measure as much as two inches across, but specimens are often found much smaller than this; like all wood-feeding insects, they vary greatly in size. The abdomen is attached to the thorax by the whole of its base, instead of the slender peduncle that constitutes the familiar and proverbial wasp's waist.

But the most interesting part of the insect is the ovipositor, which consists of three parts, two yellow side-sheaths, which are toothed outwardly towards the extremity, and a black central borer, which is notched at the end, and is therefore able to act something like a gimlet. This instrument runs up underneath the abdomen, and has its origin more than half way up the latter; it also projects beyond the abdomen to about the same extent, and measures almost an inch in total length. In addition to this, the last segment of the abdomen is produced above into a long and stout spine, which is nearly half as long as the free part of the ovipositor. With the ovipositor the mother pierces the bark of the tree she has chosen for the support of her progeny, in order that she may deposit her eggs in such positions as shall place the young grubs in circumstances of comfort and opulence from the moment they first see the light.

Her consort is altogether a slenderer, smaller insect, and has a reddish body, without the mourning band—and, of course, without the formidable boring apparatus; all he can show in the way of offensive or defensive weapons is a very sharp point at the end of the last segment of his abdomen, in the same position as the much larger spine of his spouse.

Fig. 2.—Sirex gigas (female), natural size.

Sirex gigas is sufficiently large to show with tolerable ease a certain structure in the wings which is eminently characteristic of the Hymenoptera, though often too small to be readily seen. When spread out, the fore and hind wing on each side will be found to be in some mysterious way connected, so as to move in concert, and to offer, over the greater part of their area, one unbroken resisting surface to the air. If, however, they are waved about in various directions, they may at length be caused to spring apart, and then, if the front edge of the hind wing be held towards the light, the explanation of the mysterious union will be found. Here will be seen, running part of the way along the margin, a row of between fifty and sixty tiny hooks, bent upwards and backwards in such a way that when the wing is brought into position behind its fellow, they clasp from underneath the stout nervure which bounds the forewing on its hinder edge, and thus hook the two wings together. In the centre they are placed much more thickly than at the ends, and show a tendency to form two distinct rows. It is obvious that this arrangement greatly increases the power of the wings, and no doubt largely contributes towards that vigour of flight which is so prominent a feature in the Hymenoptera.

The larvæ are fat, whitish maggots, with six very tiny

feet in front, and the tail ending in a spine, and, from their size, it will be easily understood that they work great havoc in fir-trees in which they have established themselves, devouring, as they do, the solid timber. When the insect reaches the end of its larval life, it forms a silken cocoon in its burrow, and in this changes to a pupa, which, as is customarily the case amongst the Hymenoptera, looks like a mummy of the perfect insect. In this same burrow it enters on its perfect life by casting its pupal skin; but, when thus freed, it has still to make its way into the open air; its burrow has already been carried as far as the bark of the tree, and it therefore has now to perforate the bark in order to escape from its prison. This it does by gnawing through it, and then creeping through the opening thus made. It often recruits its strength after its exertions by sitting on the tree-trunk just outside for a time, before starting on its noisy flight.

When domiciled with man, however, its escape from its prison-house is not always so easy. At a military clothing-store in France, one of the shelves on which the clothes were piled contained a pair of *Sirices*, presumably in the larval condition when first introduced. On arriving at maturity, the insects proceeded to work their way out of the wood as usual, but when they reached the surface, they found their further progress barred by the piles of clothing, which happened to consist of a number of pairs of woollen trousers. Nothing daunted, however, they set to work upon these also, and pierced them in several directions, as they had previously done the wood, until at last they reached daylight, when, as a rather disappointing reward for their perseverance, they fell into the hands of one of the officers, who was himself an entomologist.

Like one of the longicorn beetles before alluded to, this insect has sufficient strength and perseverance not to be hindered in its burrowing operations, even by so formidable an obstacle as sheet lead—or, indeed, by a still thicker layer of the same metal. Two instances of this have been reported to the Entomological Society of France by M. Lucas. In one instance it was a lead-covered roof that was perforated, the lead being about one-eighth of an inch in thickness. The other was a very curious case. It occurred in an arsenal at Grenoble. A box of cartridges was discovered in which some of the bullets had been pierced by these insects, the explanation apparently being that the larvæ had been in the wood of which the box was composed, and that the perfect insects, in endeavouring to work their way out, had directed their course inwards instead of outwards, and had thus encountered the cartridges, through which they had been compelled to eat their way; some of them, however, had perished in the attempt, and they were found dead in the box, with their beautiful yellow bodies blackened with the lead and powder.

There is an allied species, called *S. juvencus*, in which the female has a shorter ovipositor, and is entirely of a splendid steel blue colour. This also occurs in houses, similarly to *S. gigas*, which it equals in destructiveness as well as in size. Some years ago, no less than two hundred fir-trees were destroyed by this insect on a large estate in Norfolk. It seems probable, however, that the *Sirex* must not be charged altogether with this wholesale destruction; the insects appear to have a tendency to attack trees that are already enfeebled by disease or damage, instead of those that are vigorous and healthy, and, therefore, perhaps in some cases they merely accelerate a death which could not have been long delayed. Still, of course, when they do attack a tree, they often utterly spoil the wood as timber, by their numerous burrows in all directions. As an instance of this, we may take a tree that was found in Bewdley Forest some years ago. Twenty feet of the length of this tree was so perforated by this insect as to be completely useless as timber, and serviceable for nothing but fire-wood. It was transferred to an outhouse, and while lying there for some months, the insects emerged from their burrows at the rate of some five or six a day. It is curious to note that the first specimens hatched were chiefly males, but, as time went on, the females became more numerous and the males less so, till at last only females appeared.

(*To be continued.*)

THE EARTH'S PAST.

By Richard A. Proctor.

The earth's surface has long been recognised as presenting a stupendously difficult series of problems — problems indeed which can never be fully solved. So soon as men gave up the old idea that the crust had been fashioned originally much as it is now—so soon as, turning over the leaves of the great earth-volume, they began to read what is recorded there, they found, in the first place, that the record runs back over millions of past years, and in the second place, that it is full of gaps, of blurred pages, of scarce interpretable passages. Yet imperfect though the record is in many places, and hard to read in others, it at least tells us clearly the general history of the earth from the time when first there were lands and seas in her surface as now, and when the rival forces of denudation on the one hand and of land-making on the other began the contest which has continued for millions of years in the past, and will last for millions of years yet to come.

We no longer, indeed, look back over such a uniform series of changes as the earlier students of geology contemplated. We no longer regard the layers of the earth as comparable with those of an onion, or formed in uniform succession as to time. We see, for example, that even as, in our own age, the denuding forces are forming new strata out of the materials of Quaternary rocks here, out of Tertiary rocks there, of Cretaceous, Jurassic, and Triassic rocks elsewhere, and in other vast regions, even out of the Primary rocks down to the Lower Silurian and Cambrian, nay even to the Archæan rocks themselves, so it has been all the time. The crust of the earth has never presented features purely Pleistocene, or Pliocene, or Miocene, or Eocene—or presented, indeed, any uniform aspect at all; and as the formations have never been uniformly presented, so also the strata have never been uniformly laid down. We can no more say the earth was at one time carboniferous and at another cretaceous, than we can say that the soil of England was in such and such an era waste, at another time pasture land, at another crop land.

Yet we can look back over the past history of the earth and recognise her constant, though not uniform, progression from her Archæan condition to her present state.

The problems thus presented by the earth's history, while stupendously difficult in detail, are yet so far soluble that we can find in the action of air and water on the one hand, and subterranean forces on the other, the explanation of the general progression of the earth to

her present condition. It is otherwise with those prior changes by which the earth passed to the stage when she was fit to be the abode of living creatures. We have evidence, indeed, here also, but it is not so close at hand. We have knowledge of the chemical and physical laws involved in the problem, but the conditions under which the processes then taking place proceeded were unlike any under which we can now experiment. So far as I know, the problems suggested by the consideration of the earth's fiery youth have not been as yet very closely dealt with. Let us note some of the evidence, and some of the points which may fairly be regarded as clear.

In the first place, I think we are too apt to regard a planet in its fiery youth as more uniform than the earth is as we recognise it now. We find the idea common that there would be a molten mass, with perhaps a solid nucleus and a solid crust, and outside that, a complex atmospheric envelope, high up in which would be suspended immense layers of cloud, enshrouding the real planet from outside view. These ideas seem as likely to be erroneous as the common idea of the earth as enclosed in a uniform series of strata before wind, rain, and storm cut her surface up into mountains and valleys, hills and dales, ravines and gorges. Probably the structure of the earth, when in its fiery youth, was even very much more complex than the contour of the earth's crust is now. All the conditions favoured tremendous disturbances. The upheavals and down-sinkings of the crust, for instance, would be very much more active then than now, though it does not follow that the resulting inequalities of level would be greater. Indeed, they would not be nearly so great, for the simple reason that, whatever the actual materials of the forming crust in those times, the intense heat pervading it would suffice to render it too unstable to be able to stand out to very great heights above the mean level. But consider how rapidly it would be changed by the subaerial forces which in those days must have been at work.

On our present earth we have an atmosphere of oxygen and nitrogen producing a pressure of about 15 lb. to the square inch; water is from time to time added to it in the form of vapour raised by the sun's heat from the sea, and it is this water, forming into clouds, and pouring down on the land, which leads to all the denuding work of river, cataract, rain, snow, ice, and glacier. In addition, there is the direct denuding action of the air in wind and storm, the direct denuding action of water as the waves of the sea pulsate on their shore-lines.

But such denuding forces can be absolutely as nothing compared with the denuding forces which must have been in operation when the earth was young. It is certain that the oxygen and nitrogen now present in the air are but a residuum of what was once there. But besides these gases, now in due proportion for the support of the earth's life, there were immense quantities of carbonic acid gas, of sulphurous acid, sulphuretted hydrogen, chlorine, boracic acid, and other destructive gases, some ready to assume the liquid form, and so to be still more destructive. But there would also be immense quantities—whole oceans one may say—of water in the form of vapour. The pressure of that primeval atmosphere would have been so great that the waters of such oceans as would have existed then would not have turned into steam save at a temperature so far above the boiling point at the present atmospheric pressure, that the surface of the ocean would actually have glowed with inherent lustre. The water-vapour in the air would have been no such cool and pleasant vapour as now exists in our air, but steam at high pressure and intensely hot. The rains falling then would have been torrents of hot water, impregnated with destructive acids, and falling on intensely heated rocks, ready to respond with intense rapidity to the destructive influences of those falling torrents, and of the dense, complicated, and destructive atmosphere through which they fell. We may be well assured that the changes taking place in the aspect of the earth's surface during that remote part of her career were far more rapid than those taking place now.—*Newcastle Weekly Chronicle.*

ELECTRICITY AT HOME.

By W. SLINGO.

EXPERIMENTS WITH AN ELECTRIC MACHINE.

THE various parts of the electric machine constructed on the plan detailed in my previous article require some little care in fitting together, and no pains should be spared to ensure this being done as perfectly as possible. The great feature, of course, is that the framework should form a rigid structure, and one that is not likely to fail in any part. If one of the uprights affords a firmer fit than the other, it should be selected as the one which is to be nearest the handle, and it is also this one that should be cut across at the bearings (as in Fig. 3, p. 25). Presuming the experimentalist is right-handed, so that he would be best able to revolve the cylinder from him, that is, by moving the handle in a similar direction to that taken by a watch-hand, then the rubber and its support should be placed on the side of the base nearest him, and necessarily the prime conductor should be placed on the opposite side.

Before attempting the production of electricity, the leather surface of the rubber should be coated with amalgam. A small piece or strip of tin-foil should connect the amalgam with the foil coating on the cylinder. The silk rubber should be laid over the amalgam—a method which will be found preferable to that of coating the rubbing surface of the silk directly.

It is essential for the production of any quantity of electricity that there should be a complete "circuit," or path, for the electricity to travel; from the rubber to the prime conductor (by way of the moving cylinder) thence back again directly or indirectly to the rubber.* More often than not, the earth forms a part of the "external" circuit (that portion external to the machine itself). Should we wish to collect a charge, or secure a series of flashes or sparks, we shall find that in most cases it will best suit our convenience to connect either the rubber or the prime conductor direct "to earth," or to some other conductor connected therewith. In many machines the rubber is made in electrical connection with the framework, whereby a more or less perfect earth is "made," by way of the table, floor, &c.

By providing the rubber as well as the prime conductor with an insulating support, we are, however, able to secure a charge of positive or negative electricity at will.

* It is to be observed here that, although I speak of the electricity travelling from the rubber to the prime conductor, I only use this way of expressing the phenomenon in question because it is the simplest mode of dealing with it. To enter into the question fully would occupy several pages, and for those who are sufficiently interested in the controversy there are many works on the subject available.

For the purpose of making the connections, procure a couple of copper or brass washers (like those used in making the handle) about five-eighths or half an inch in diameter, and furnish it with a hole (A, Fig. 1) about an eighth of an inch in diameter. Drill two other holes, B C, large enough to allow stout brass pins (or nails) to pass through. Round off, with a file, any asperities, and then pin one of the pieces of metal on the wooden cylinder carrying the rubber, placing it in the centre of the outer side or that side remote from the glass. A gimlet or bradawl should next be used to make a hole in the wood corresponding with the hole A (in Fig. 1). Into this hole drive lightly a short brass-headed nail (such as is frequently used for hanging pictures). It would be an improvement to sink the brass washer or collar into the wood by making a shallow hole therein with a brace and centre or twist bit of the necessary size. If the washer fails to make contact with the foil coating of the wooden cylinder, a piece of tin-foil should be pasted on so as to preserve the electric continuity.

Fig. 1.

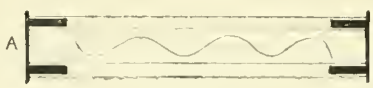


Fig. 2.

Fig. 3.

The other washer should be similarly fixed on the outer side of the prime conductor, and should be likewise furnished with some such article as a brass-headed nail for connecting purposes. The nail should not, however, be fitted tightly, as it will often be found advantageous to remove it and substitute a piece of stout iron or other wire, provided at one end with a metallic or metal-coated ball. A very efficient substitute for a metal ball is a wooden one, painted with gold-size and rolled over a Dutch metal leaf until it is fairly covered.

The machine being now fully equipped, warm it thoroughly before a clear fire in a room free from draught, as a moist atmosphere is fatal to experiments with an electric machine. Then procure a piece of wire, eighteen to twenty-four inches long, thickly coated with gutta-percha. Failing this, attach one end of a piece of bare wire to the rubber-cylinder, and warm over the wire, at about six inches from the other end, an ordinary stick of sealing-wax, to serve as an insulating handle. Bend the free end into a ring, or fasten it to a conducting ball, such as a brass ball or even a rounded piece of apple or potato. Bring this, while the machine is being turned, near enough to the prime conductor to enable sparks to pass, and copious and brilliant discharges can be observed.

Similar, but possibly not always such satisfactory, results can be obtained by connecting the rubber with a gas or water-pipe, or some other conductor, reaching to the earth, and then bringing an earth-connected rod near the prime conductor. These two experiments, be it observed, are identical in principle. A very interesting and somewhat striking experiment is illustrated in Fig. 2, where a piece of glass tubing, half an inch in diameter and ten or twelve inches long, has pasted round it in spiral form a series of small diamond-shaped pieces of tinfoil, placed about an eighth or quarter of an inch apart. Over one end is fixed, by means of cement—say, plaster of Paris—a brass cap (Fig. 3), consisting of a piece of brass tubing half to three-quarters of an inch long, soldered to a circular piece of this sheet-metal, three-eighths to half an inch larger in diameter than the brass tubing. Then is fitted loosely over the outside of this brass tubing another piece of glass tubing of the same length as the smaller tube. Finally, another cap, similar to Fig 3, is fitted on the free end of the apparatus. The object of the outer glass tube is twofold. In the first place, it protects the pieces of tinfoil; and, in the second place, it facilitates the operation of rotating the inner tube with one hand while the outer tube is clasped in the other hand. To work the apparatus, hold one of the conducting knobs in the hand (or by some other means make an earth connection), and place the other knob near the prime conductor. On the machine being turned, numberless sparks will dart across between the pieces of foil, the attractiveness of the effect being greatly enhanced by revolving the tube.

The tube may be made to revolve automatically at the cost of a little more care and labour. The apparatus is illustrated in Fig. 4. For this a separated insulating stand may be used, or a small hole may be bored in the top of the prime conductor.* Into this fit a short piece—say, three-quarters of an inch long—of iron (the diameter being such as to fit the hole loosely). To the upper end of the rod solder a round piece of thin sheet brass about an inch

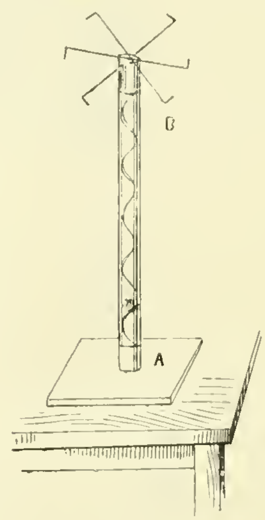


Fig. 4.

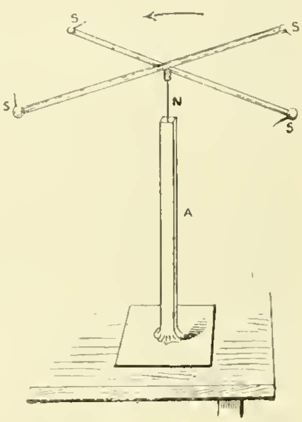


Fig. 5.

in diameter, and having soldered to its upper surface a piece of brass tubing three-quarters of an inch long and large enough to fit the outer glass tube of the spiral fairly well (either inside or outside). The inner tube is provided at the bottom with a pivot, which may consist of a short pointed piece of steel attached to a wooden plug fitting inside the tube. A hole should be drilled through the brass disc large enough to allow the pivot to rotate freely, the point working on the smooth end of the subjacent iron. The lowest piece of foil on the tube should be connected electrically with the pivot.

The upper end of the inner tube should be fitted with a cap, consisting of a piece of brass tubing surmounted by a round piece of thin sheet brass, the brass tubing extending for an inch or so above the outer glass tube. On to the cap solder a number (three or four) of thin wires about eight inches long, and with about half an inch at each end bent horizontally and at right angles, all the bent portions, or "points," pointing in one direction (as viewed in walking round a concentric circle). The parts should all be as light as possible, and should balance well. If the apparatus thus made be put

* It would be advantageous to let in, in this case, a piece of a small brass tubing having an internal diameter of three-sixteenths or a quarter of an inch. It would in some instances prevent damage being done to the cylinder.

together, and placed on the prime conductor, electricity will, when the machine is worked, pass up the spiral, and so to the points, where, on escaping, it produces a perceptible wind, having sufficient force to drive the "electric mill" round in the opposite direction to that of the points.

A simple form of electric mill may be made by sticking a needle, eye downwards (N, Fig. 5), into the end of a dry wooden rod or a stick of sealing-wax (A), and balancing on the point, the moving portion consisting of two or three straws (S S), about eight inches long, stuck together at their centres with sealing-wax, and furnished with fine wires passing through the straws, and bent at their extremities so as to produce the "points," all of which should be turned in the same direction. A small piece of straw or a fine glass cone (made by heating a piece of glass tubing, drawing it out, and cutting the part off for the cone) being fastened to the junction of the straws by means of sealing-wax completes the apparatus, which may be worked from the table by connecting the needle with the prime conductor, and turning the machine.

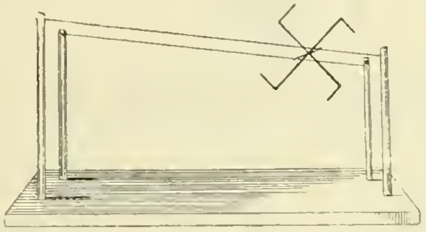


Fig. 6.

In Fig. 6 is illustrated another simple piece of apparatus dealing with the effect of points. A wooden base measuring about nine inches by five is provided, and is fitted at one end with glass rods a quarter of an inch in diameter and about eight inches long, the other end being fitted with similar rods five or six inches long. Straightened pieces of wire are attached to the upper ends of the rods as shown in the diagram either by being soldered to brass caps fitted on to the glass, or they may be simply stuck on with a little sealing-wax. A third and very efficient mode of fixing is to fit paper tubes three-quarters of an inch long over the tops of the rods, and passing the wires through holes made for the purpose in the sides of the tubes (about half their length being left about the rods), to fill up with a cement composed of equal parts of powdered resin and beeswax melted together and mixed with a somewhat larger proportion of red ochre. The next thing is to make the mill, which should consist of four pieces of thin wire, each three and a half inches long and bent at the ends at right angles (as shown). A small thin metal disc drilled at the centre should be fitted to a piece of wire stout enough to form the spindle, and the bent pieces soldered to its sides, as little solder as possible being used, and care being taken to keep the mill as nearly balanced as possible. The mill being placed on the lower ends of the inclined wires, and these wires connected with the prime conductor, the discharge of electricity from the points will cause the mill to revolve, and in so doing to ascend the inclined plane. Obviously the mill must be placed on the wires with the points in the direction shown in the diagram.

A sheet of note-paper may be made to yield both interest and instruction. To the knob (*c*, Fig. 7), on the wire attached to the prime conductor (or to the conductor itself) attach a stout wire of any convenient metal, bent to the shape shown, the end B being turned up so as to form a hook. Over this hang a sheet of foreign note or tissue paper cut into narrow strips. On turning the machine, the strips fly apart by mutual repulsion. If the hand be brought near attraction towards it results;

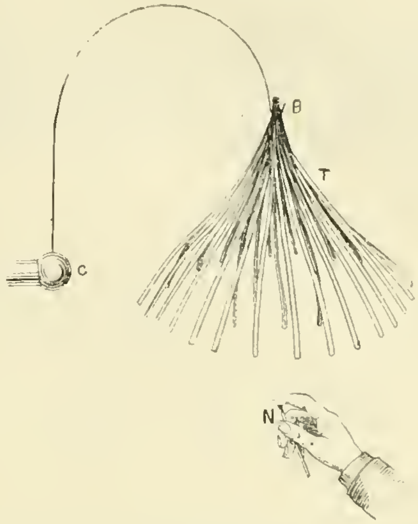


Fig. 7.

the same is observed if a needle be approached (sideways), so long as it is covered by the finger, but if the finger be withdrawn, the strips will be blown away, although if the needle be held upright under the hook, so as to be opposite the centre of the tassel, discharge ensues, and the strips fall together (as in Fig 8).

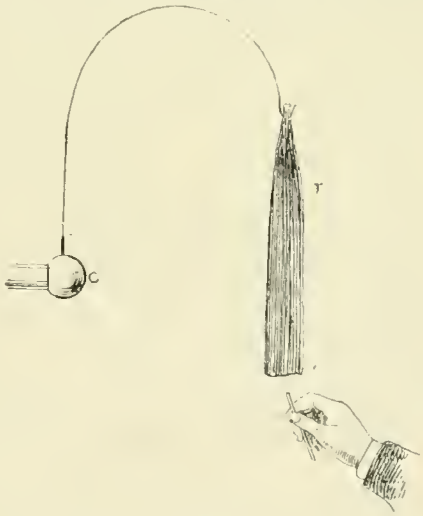


Fig. 8.

The principle involved in this experiment is a highly interesting one and, properly understood, is capable of rendering intelligible many of the apparently more intricate experiments and many of the phenomena pertaining to atmospheric electricity. To some of these latter our attention will next be directed.

A highly interesting and simply constructed piece of apparatus is that illustrated in Fig. 9, where A B is a piece of stout wire, eight or nine inches long, provided at its ends with small conducting balls, either of metal or of wood, &c., coated with Dutch metal or tin foil. From the ends two-inch bells, C, D, are suspended by

short lengths, say four inches, of common brass chain, and from the centre a similar bell, E, is suspended by means of a piece of silk thread equal in length to the chains. From E a third chain hangs and is connected with some conductor in contact with the earth or with the rubber of the machine. F, G, are two small conducting balls, about half an inch in diameter, suspended by silk thread, and normally hanging midway between the bells. A hook, made by bending a piece of moderately-stout wire, is soldered on to the centre of the suspension-rod, and is intended to be placed over the rod in con-

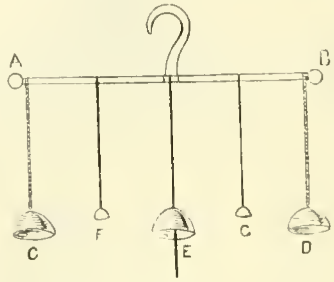


Fig. 9.

nection with the prime conductor. On the conductor becoming charged, the balls will be seen to oscillate between the bells, striking them in turn. The *rationale* is not far te seek if we remember that the charge on the conductor (to which the outside bells are electrically connected) is very large in comparison with the capacity of the balls. Supposing the ball F to be inductively electrified, and consequently attracted by the ball C, it will come into contact with that bell, and will at the same instant become similarly charged and necessarily repelled. But being repelled from the similarly charged bell, it is also attracted by the earth-connected and so-called neutral bell E, on coming into contact with which the ball loses its charge, and would then fall back into the vertical position. This, however, it is prevented doing in virtue of the attraction, which is again exerted between it and the bell C. In this way the oscillation of F is maintained so long as any charge remains in C. The ball G is actuated by precisely similar influences, the bell D being in the same electrical condition as C. Were there a given charge imparted to the conductor, and the bells C, D, then F, G, would act as small carriers, and would in time dissipate the whole of the charge. The apparatus can also be used in connection with the Leyden jar (see below), E being connected, directly or indirectly, with the outer coating, and the hook with the insulated inner coating.

Considerable amusement may be afforded by standing a boy on a dry board of any convenient size, resting on four dry, in fact hot, tumblers, and connecting him by a wire or chain with the prime conductor. If the hand of a person standing on the floor be passed over the boy's head, his hair will be attracted to the hand, and will, therefore, stand erect. When the experiment is performed in a dark room, every tuft of hair will be seen to glow with small brushes of electric sparks, as the charge is conveyed through the hand to earth. Another boy (or girl, for the matter of that) can be employed in drawing sparks from the legs, arms, back, or other parts of the electrified boy's body. His finger placed at a short distance (an eighth of an inch or so) over a gas-burner, will emit a spark which, if the tap be turned on, will ignite the gas.

To a party of young people, few things are more entertaining than a Leyden jar (Fig. 10), which lends itself in a great variety of ways as a source of amusement and instruction. By its aid all the phenomena of lightning can be illustrated; but this is only a small portion of its capacity for entertainment. It is a piece of apparatus very simply made. It is to all intents and purposes the same in principle as Franklin's pane or plate, which consists of a sheet of thin glass, say twelve inches square,

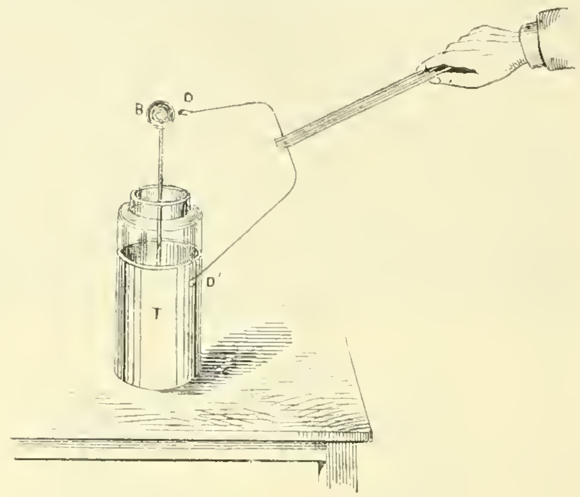


Fig. 10.

having gummed on to each face a piece of tin-foil nine inches square. The inch and a half margin on each face should be coated with shellac varnish. One metal sheet should be connected with the earth, and the other with the prime conductor. The charge on the conductor extends to the connected plate, and accumulates there in virtue of the attraction exerted by an opposite, but equally powerful, charge, gradually induced and accumulated on the opposite or earth-connected side. On a piece of wire, melted into the end of a stick of sealing-wax (for a handle), being connected at one extremity with the earth-connected face and the other extremity brought near the other face, a more or less intense spark will be observed. Perhaps the Leyden jar is a handier form of "condenser," as this class of apparatus is called. It consists of a glass jar or bottle, of say a quart, or even larger capacity, with a neck at least wide enough to allow the hand to be passed in and out readily. The thinner the glass the more efficient will the instrument be, but in the absence of the orthodox shape, a French plum jar will answer admirably. It is coated, inside and outside, with tin-foil (which can easily be gummed on) to within an inch and a half or two inches of the neck, this portion being left uncovered and kept scrupulously clean. A ball, B, an inch to two inches in diameter, either of metal or of wood, coated with tin-foil is attached to a piece of stout wire or rod long enough to reach from the bottom of the jar to two or three inches above the top of the neck, the lower end of the rod being attached to the foil on the bottom (inside) of the jar by a little wax. If convenient, it is perhaps preferable to use a cover or stopper of hard baked wood saturated with paraffin wax, and provided with a hole through which the rod should be passed and fixed in it. In this case the rod need only pass an inch or two below the cover, contact with the inner coating of foil being made by means of a piece light brass chain. Before using the instrument it should be thoroughly warmed to evaporate any moisture that may

have collected on the uncovered glass. To use it, place the knob B in connection with the prime conductor and the outer coating with the earth.

On turning the machine the jar will speedily become charged, and intense sparks will pass on the discharger being presented as shown, the knob D′ being placed in contact with the outer coating, and the other knob, D, brought near the knob B. A piece of insulated wire will answer the same purpose. If, instead of the discharger, a number of boys join hands, and the two end boys touch the jar, one placing his finger on the outside and the other afterwards touching B, a shock will pass through them; but a little care should be exercised, or a shock too severe to be pleasant may be experienced. Two or three turns of the machine should be made, and the effect tried, more prolonged chargings being afterwards administered if the experimenter's *clientèle* can bear it. The contortions and exclamations of those who experience the shock for the first time call forth bursts of laughter and provoke merriment of the most uproarious character.

Equally interesting experiments on the heating-effects of the spark can easily be performed. Put a little methyllated spirits in a spoon, and connect the latter with the outer coating of the jar. Then bring a discharger connected with the knob B over the spirit, which on the passage of a spark will ignite. Place a little gunpowder on a slab of stone or brick, connect one part of it with the outer coating of the jar, and connect another part with a piece of wet string attached to one end of the discharger. When the jar is charged, bring the other end of the discharger near B, and the powder will ignite. For another interesting experiment, make a mixture composed of equal parts of powder chlorate of potash and bisulphide of antimony. Make a paper tube a quarter of an inch in diameter, and an inch and a half long, by coiling the paper round an ordinary lead pencil, and gumming the layers together. Fill one end up with a short plug of wood, through which pass two pieces of fine wire, and let them come near each other, taking care that they do not touch, then cover the points with the mixture, fill up with gunpowder, and gum a piece of paper over the open end. Connect the fixed wires by means of other long pieces of wire, one with the outer and another with the inner coating of a charged Leyden jar, when the little "mine" will explode with some violence. By coating the paper case and the connecting wires with pitch, the appliance can be made waterproof, and may then be immersed in a bucket of water and exploded therein, with the result that the water will be blown in all directions, and if the mine or torpedo be a trifle larger in its dimensions, the pail will, in all probability, be blown over. There is no danger of the mines going off spontaneously, but they would, of course, if hammered, or otherwise severely struck. So long as they are handled properly, they can be made and used with perfect safety.

Such are a few of the many experiments which an electric machine can be used for, but few as they are they are quite sufficient to afford entertainment for an hour or two, and in my next I shall deal with another batch of experiments quite as interesting and perhaps more instructive.

It has been said that every man is either a fool or a physician at forty. With equal truth it may be said that at fifty (at latest) every man not a fool is a theologian,—in the sense that he has determined his own system of religion, both as regards worship and conduct.

AMERICANISMS.

(Alphabetically arranged).

By R. A. Proctor.*

I HAVE been requested by so many to complete my papers on "Americanisms," that I resume the series, repeating what had already appeared in a late number of the weekly Knowledge as the only way of giving the full set of papers in the current series. It was by an unfortunate mistake that the first part, written when I was in America and sent thence by post, appeared earlier than had been intended; and the mistake had led me to decide on discontinuing the papers, as I neither cared to continue them in a new series, nor to reprint the three columns which had already appeared. As, however, the study of Americanisms is useful in these days, when many American novels are read, and many English writers attempt, more or less successfully, to picture American scenes, the series is now resumed, to be continued monthly till finished.

Abrogans or *Abergoins* is the Western way of calling the natives or Aborigines.

Absquatulate signifies to run away. It is now less often heard than of yore, having been replaced in some degree by the word "skedaddle."

Account, "of no account" is a way of expressing worthlessness. *No account* becomes an adjective: "no account men," Bret Harte says, meaning worthless fellows. The latter usage alone is distinctively American.

Admire. To wonder at. Often used with at. "I admire at that," for I wonder at that. The expression is good old English.

After night, in the middle States, means "after nightfall." English also.

All-fired, a polite form for Hell-fired,—the meaning is not mistakable.

All to pieces, and *all to smash* signify "utterly." English also.

Allow. To assert, affirm, or merely to express an opinion. This expression is often put by English writers in the mouths of Yankees; but as a matter of fact it is only used in the Southern and Middle States.

Along. "Get along" is used in America where in England we should say "get on." Used in many parts of England.

Anan. Leatherstocking's expression. I have only heard this once,—at an eating-house in Pittsburg. The expression is used in Pennsylvania.

Ante. To *ante* a sum, is to risk it. The expression belongs to a game called poker, much played by the lower class of gamblers, horse-thieves, politicians, cowboys, and the like.

Anything else. Not,—meaning "just that." If an American is asked whether some one really did such and such a thing, and he wishes to emphasise his reply, he will say, "He didn't do anything else."

Apple Brandy and Apple Jack. A strong liquor fermented from apple juice. When good, *very* good.

Approbate, is sometimes used in America—incorrectly, of course—for "approve."

Arkansas Toothpick. A bowie-knife, with closing blade. I have never seen an American pick his teeth with an

* I have taken as my chief but by no means my sole authority Bartlett's "Dictionary of Americanisms."

Arkansas Toothpick; but I can believe *anything* about tooth-picking in America. The public display of such arrangements as any American finds desirable for his or her teeth must be regarded as a national institution.

Around. "To be around" is used in America for "to be near" or "by." Thus a preacher in America spoke of Mary as "standing *around* the cross."

As, for "that." "I don't know as I shall go there," &c. "Only heard among the illiterate" says Bartlett; but I imagine that nine out of ten whom I have heard use this ungrammatical expression would be offended if they were described as illiterate. I have heard college professors use it freely. Of course it is often heard in England also.

At is sometimes used for "in," as "at the north" for "in the north."

At that, an odd expression used to intensify something already said, as "He is a Methodist and a hypocrite *at that;*" "he has an ugly wife and a shrew at that." Probably an abbreviation of "added to that."

Awful, used for "very," is purely American, though *awful,* used wrongly as to meaning but rightly as to grammar, is now common enough in England. In the Eastern and Middle States one often hears "awful handsome," "awful hungry," and so on.

Ax, To (for to ask), is a Yankee relic of a very old English word, still used in many parts of England.

Back of is used for "behind"; "you'll find the stick back of that box." Used in England.

Back Down. To "back down" is to yield.

Back Out, To. To retreat. Used in England.

Back track. "To take the back track," is to retreat.

Backwoods, the woods behind or "back" of cleared land.

Bad lands. Waste lands unfit for any sort of agriculture, and hard to travel through. The French settlers called these *Mauvaises terres,* a name still remaining in the form "Movey star."

Bad. Constantly used for the adverb "ill" or for "badly." I feel bad, is not in America an admission of moral depravity, but means simply I don't feel well. So, "I feel good" is not Pharisaic, but means I am well and happy. "Drink that wine, it will make you feel good," would mean that the drinker will feel jolly after his draught. Where something nice, though (conventionally perhaps) naughty is referred to, the expression "it will make you feel good" has a singularly odd sound in English ears. See *Chemiloon.* (The reference is all right, perplexed reader.)

Baggage, is used in America where we say "luggage." The word "baggage" in England has often another meaning. "To say that a man had a little baggage" with him might be misunderstood in England. A story is told of an English wife in America being told that her husband had arrived with "a little baggage": She went to look for that little baggage with a potato-masher.

Baggage-smasher, the name very appropriately given to the persons who move baggage to and from cars, &c.

Balance, the rest. "Peter and Andrew, with the balance of the twelve, stood around."

Bang-up. First-rate.

Bankit. I heard this expression once only, in New Orleans, for side-walk. (Fr. *banquette.*)

Bay, The Bay State, is Massachusetts. "Let the grand old Bay State proudly," said Lowell, "put the trumpet to her lips," &c., saying, "you go one way we go t'other, guess it wouldn't break our hearts,"—an early cry for Secession,—forgotten subsequently by the North. But the South maintains still that the Northern States were the first to secede from the Union, by failing to adhere to the constitution.

Bayou. The outlet of a lake.

Bear State. The State of Arkansas, so named from its more characteristic inhabitants.

Beat. As a verb, to surpass. "That beats all ever I heerd." Also to astonish, to overcome. "That beats me," means that is utterly surprising to me. But "I'm dead beat" means I'm thoroughly tired.

Beat as a noun also has two meanings. It means some thing or person surpassingly good or effective or surprising, as, "I never saw the *beat* of that." But a "beat" is also one who is thoroughly exhausted, generally in pocket. A "dead beat" is for instance a man without a cent, and not willing to earn a cent.

Bed-spread. A coverlet or counterpane.

Bee. A gathering of friends and neighbours to get through work for a person or family.

A *spelling-bee* is a gathering to test skill in spelling, and tolerably dreary such gatherings are. *Crede experto.*

Bee-line. A straight line,—where in England we should say "as the crow flies," an American would say "on a bee-line."

Being as, an elegant way of saying "since" or "because." "Being as you're a friend," would mean, since you are a friend, or considering that you are.

Beliked, for liked: probably as justifiable in reality, though not by English usage, as "beloved" for "loved." It is, however, often heard in England, too. Shakespeare has "belike" for "probably."

Belongings, used sometimes for property, but occasionally as a euphemism for trousers, a "gentleman's belongings." The former use is good old English.

Bender. To "go on a bender" is to start on a frolic. An unbender would seem nearer the mark.

Best. Used as a verb, meaning to get the better of.

Betterments. Improvements. *Bettermost,* for the best.

Biddy. An Irish female servant.

Big. Used not only for "large," but for fine or excellent, as "big whisky" for whisky of first-rate quality.

Big Bugs. Persons of consequence.

Big meeting. A term applied to camp-meetings, gatherings of people for religious services of the sensational or hysteric kind, a custom invented by the coloured people, but known also in the wilder parts of Ireland. Some persons in America find it good business, I am told, to attend these religious gatherings,—they get a holiday and credit for being more religious than those who keep away.

Biscuit. A biscuit in America means what we would call a hot roll in England. Some are much smaller than our hot rolls; but they are the same in character. They are indigestible to a degree; but Americans will assure you (with face dismally contradicting their words) that hot biscuits are good and healthy food.

Bishop. A "bustle,"—article of feminine gear.

Bit. I must admit great ignorance as to the real meaning of this word. In the South, a "bit" is generally half-a-quarter, *i.e.,* 12½c., equal in value to our English sixpence; but I have known a quarter and a dime (25c. and 10c. respectively) called a "bit." I believe, however, a bit usually means 12½c.

Blamed, condemned theologically, *i.e. damned.* I suppose this particular use of the word belongs to the old country. I had a clerical master who used to say "Blame the boy," with as much unction and as obvious relief as though he had said, "Damn the fellow."

Blanked. Similarly useful.

Blaze. To blaze trees is to cut a mark on them, showing brightly at a distance.

Blazes. Equivalent to *Sheol.* Words beginning with "Bl" seem in favour for strong language. Hence probably the absurd "Blue Blazes," and our vulgar English "Bloody" and "Blasted." (Mr. Max O'Rell's "By'r Lady" for "bloody" is simple nonsense.) Also Blow it, Blast it, &c. It would be interesting to compare scientifically the relief derived respectively from Blame, Blank, Bloody, &c., on the one hand, and Damn, Deuce take it, and Darn it, on the other.

Blizzard. A particularly biting wind. Also a poser.

Block. A set of houses enclosed rectangularly between four streets.

Bloomer. A term applied to costume devised by Mrs. Bloomer,—a short gown, reaching a little below the knees, and pantalettes.

Blow. To boast loudly. "I guess, old man, you're blowing."—*Artemus Ward.*

Blue. Till all's. An amazing expression, generally applied to drinking. "We'll drink till all's blue." I know of no physiological explanation of the expression.

Blue Fish. A large kind of mackerel. The "blue fish wriggling on a hook" was the first American fish I became—vocally—acquainted with, thanks to Mrs. Florence, somewhere about 1856.

Blue grass. The grass growing on the rich limestone land of Kentucky and Tennessee. But in the "Hoosier Schoolmaster," the scene of which is laid in Indiana, we read of "the blue grass pastur'."

Blue Nose. A Nova Scotian, so-named, says Sam Slick, from the blue nose potato, which the Nova Scotian rears in perfection. I would wager a cent, were I a betting man—a cent in America or a farthing in England—that the Nova Scotians were called "blue noses" before the potato which they rear was so named. I guess—after living four years in America I may guess—the name referred to the blueness of nose resulting from intense cold.

Blue Pill. A bullet.

Bluff. Verb. To bet on a worthless hand. This is regarded as a creditable achievement at the noble game of poker. Outside that game, it is generally known as lying.

Board round. To lodge in succession in different families. School teachers were welcomed in this fashion formerly, and perhaps are still boarded in this casual, and (I should imagine) most unpleasant way.

Bogus. Equivalent to our English *Brummagem.* The term has been described as a corruption of *Borghese*, the name of a man who forged bills half a century or so ago. The explanation seems doubtful,—a bogus explanation in fact.

Boiled shirt—or more frequently *Biled Rag*, a clean shirt: a singularly graceful expression.

Bolt. Verb. To bolt a candidate is to omit to vote for him.

Bonanza. Spanish. A big scheme, by which (honestly or otherwise) much money is made.

Boodle. (Fr. *Botel*; Germ. *Beutel*; our English *Bottle* is of similar origin.) A set or lot. The "whole boodle," the whole lot. Somewhat emphatically contemptuous.

Boost. To hoist. Old English.

Boss. (Dutch *Baas.*) A master or overseer. As an adjective "boss" means "biggest."

Bottom Dollar. The lowest dollar of a heap set beside the gambler wherewith to back his luck. "You may bet your bottom dollar," is equivalent to "you may go your whole pile" (of dollars). One of the elegant offshoots of American gambling.

Bound. Meaning "sure," also "resolved."

Bourbon. Whisky from Bourbon county, Kentucky; the best whisky I know. (If you know any better, then —*candidus imperti; si non, his utere mecum.*) Also, a term applied to Democrats.

Box Car. A close car, used to convey furniture by rail.

Boy. In the south this word usually means a coloured male servant.

Brainy. A man who shows brain power.

Breakdown. A riotous dance, closing a ball.

Britishers. Americans say that this word is purely British, no American being ever heard to apply it to Englishmen. Bartlett says in his "Dictionary of Americanisms" "We never heard an American call an Englishman a Britisher." Curious! I had not been in America ten days, before I had heard many Americans speak of Englishmen as Britishers — generally, as "blarsted Britishers." Oddly enough, Englishmen lay themselves open to similar contradiction, when they assert that this word "blast" with its derivations "blasted, blastedly, &c.," is much oftener heard in America than in England. No one but a blackguard in England ever uses the word; but in America they are so fully assured that every Englishman is always "blasting" that they use it freely. So with "bloody"; it is a familiar word with English costermongers, but no respectable Englishman ever uses it: now it is thought nothing wonderful for an American lady to speak of "crying bloody murder," or of "raw-head and bloody bones," at which her English cousin, unless of low grade, cannot help shuddering.

Broncho. A native California horse, of somewhat lively type.

Brother Jonathan. A term originally derived from a saying of Washington's about Governor Jonathan Trumbull of Connecticut. "We must consult Brother Jonathan about this," said Washington on one occasion; and this became a byword. Few Americans are christened Jonathan, perhaps, but just as Englishmen are called John Bull, so Americans are called and call themselves Brother Jonathan.

Broughtens up. Bringing up. A credit to his "broughtens up."

Brung. Niggers say "brung" for brought. It is necessary to add that white folk occasionally use this elegant form, by way of joke (very mild).

Buck. A buck nigger is a full-grown black man.

Buckeye. Ohio men are called Buckeyes. Ohio is *the Buckeye State*, so named from the Buckeye Tree *Esculus glabia*, which grows freely in Ohio.

Buckra. A white man. Nigger talk.

Buffalo. The American Bison. Also the bison's skin, or buffalo robe. They tell absurd stories of Englishmen who, hearing of a "buffalo" when a drive has been in preparation, have imagined that a bison was to be harnessed.

Buffalo Wallow. A depression in the prairies caused by rains. Bisons delight to roll in these hollows, which are therefore (!) called buffalo wallows.

Bug. Americans use this word more freely than Englishmen,—not limiting it, as we do, to *Cimex lectularius*—all insects are bugs in America.

Build. To build a fire in America is to make one.

Bulge. On the. On a big spree, (this perhaps is explaining *obscurum per obscurius*): to get horribly drunk in the company of unpleasant people, with fighting, followed by a day's sickness and several days' discomfort.

Bulldose. To bully. Bulldose was originally equivalent —so they say—to cowhide,—somewhat as a man who is bullied is apt to be cowed.

Bullion State. The State of Missouri. (A former

Missourian Senator, Mr. Benton, strove hard to obtain a bullion currency.)

Bully. Adj. and *adv.* Fine or finely.

> Now is the time for a *bully* trip,
> To shake her up and let her rip.
> *Boatman's Song.*

"Bully for you," means "well done you.

Bullyrag. To revile. Thus they *bullyrag* the presidential candidates till one or other is elected; after which bullyragging is considered bad form.

Bummer. A lazy, idle loafer.

Bundle. Verb. Obsolete. A man and woman lying on the same bed, in their clothes, were said to *bundle*, or to *be bundled.* For the full significance of the word, and the propriety of the practice, see Irving's "Knickerbockers." The Rev. I. Peters, in his "General History of Connecticut," says that though it would be accounted the greatest rudeness for a gentleman to speak before a lady of a garter or a leg, yet it was thought but a piece of civility to ask her to *bundle.*" He shows that bundling was not only a Christian custom, but a polite and prudent one!

Bunkum, or *Buncome.* Talk not meant to be taken *au grand sérieux.* A member for Buncombe, who bored many out of Congress, told the rest they might go, he was only talking for Buncombe. The practice is unknown —I need hardly say—in the old country.

Burgle. To commit burglary. Much older than the "Pirates of Penzance."

Bush Meeting. The original negro form of the modern camp-meeting. A relic of Jumboism.

Bushwhacker. The equivalent of our English Clodhopper,

Bust. A frolic. To go on a bust, is to go on a big spree. (See "Bulge.)

By and again. A Southern expression for "now and then." In England I have often heard "now and again," in this sense.

By and large. On the whole.

ANTHROPOID APES.*

THERE can be little if any doubt that by far the larger part of the insensate and unreasoning rage with which theologians have attacked and abused the theory of evolution has had its origin in that human pride which disdains to admit of the existence of any actual affinity among the higher orders of the mammalia. That any community of lineage should be claimed on anatomical and physiological grounds between the two Linnæan families of *Homo sapiens* and *Anthropormopha* is sufficient to set a good many well-meaning and conscientious (if slightly ignorant) people shrieking hysterically concerning the fearful impiety of the suggestion of those patient observers who, little by little, have shown the origin of mankind, beyond any cavil or question from any one competent to understand evidence. Everyone who wishes to understand the grounds on which it is held that man and the highest apes have a common ancestry will find them lucidly, philosophically, and temperately set forth in Professor Hartmann's book. That, as stated some years ago by Professor Huxley, the lower apes are further removed from the higher apes than the latter are from man, has never been seriously impugned; the allegation being however generally met with an attempted intellectual comparison between the gorilla, chimpanzee, or ouran-outang of the menagerie with Bacon, Shakespeare, or Newton. The fallacy and unfairness of such a comparison needs only to be stated to become evident to anyone who has ever seen a Fuegian, Bosjesman, or lower native Australian in a state of nature. For it is not intellectual purity which forms the bond of union between the anthropoid apes and the human species, or is adduced as proving it, but anatomical and physiological relations of a character practically identical, which are set forth in minute detail in the work to which this short notice is designed to direct attention. Everybody familiar either from personal observation or authentic drawings with the aspect of many tribes of negroes or of Guaranis, Malays, and Papuans will admit that their external approximation to the simian type is of the closest. Nor need the ape always fear comparison, even from a psychical or ethical point of view, with so-called "civilised" man. Without repeating Darwin's well-worn anecdote of the little American monkey which attacked the fierce baboon to save his keeper's life, we may take a recent police report, cut almost at random out of a daily paper, and contrast the behaviour and sensibility of the "Lord of Creation" who figures therein with that manifested by Mafuca, the chimpanzee at the Dresden Zoological Gardens, as narrated by Professor Hartmann. In the *Standard* of Nov. 9th, we read :—

> John Dunkin, 43, a hawker of umbrellas, was brought up, on remand, charged with causing the death of Elizabeth Jackson, a woman with whom he was living, at 3, Medland-street, Ratcliff. Last Thursday week the prisoner and the deceased woman were seen quarrelling, owing to the prisoner wanting to go and pawn the boots he had been wearing. He was then seen to strike the woman at the back of the ear with his hand, but whether his fist was clenched or not could not be said. When Jackson arrived at the lodging-house she was bleeding from the face, and also from a wound behind the ear. In answer to a question put to her by the deputy of the lodging-house, she said, "Patsy did it." A woman named Mary Ann Walford said she saw Jackson down on the landing, opposite her bedroom, and the prisoner was standing over her, and when about to kick her he was prevented. Another woman stated she saw Dunkin kick the woman in the stomach and side, and she fell to the ground. Dunkin was then heard to say, "If I had my big boots on, I would kick your face in." The woman then became very ill, and in a short time afterwards she died. When the police came and arrested the man, he asked, "Is she dead?" On being told that she was, he clenched his fists, and, looking very savagely at the corpse, said, "Nobody shall know her. I will disfigure her." A medical man stated that on the back of the ear was a lacerated wound, which was quite recent. The cause of death was heart disease, accelerated by drink and excitement. The woman must have been a hard drinker, and excitement might have been caused by the knocking about she had received. The blows might also have accelerated death. No further evidence was now adduced. Mr. Lushington committed the prisoner for trial.

Which of the so-called "brutes" could or would so degrade itself as to act towards the corpse of its fellow as Mr. Dunkin is here alleged to have done? Let us contrast the feeling he showed with that exhibited by the despised ape, when her end was approaching. Premising that Schopf was the Director of the Zoological Gardens, at Dresden, we read, "Just before her death, from consumption, she put her arms round Schopf's neck when he came to visit her, looked at him placidly, kissed him three times, stretched out her hand to him and died. The last moments of anthropoids have their tragic side." Let us beware lest in our anxiety to assert our own supremacy we are led into the moral cant. To all who wish to see a most able *résumé* of the facts from which the common origin of Man and the Anthropoid Apes must be inferred we would heartily commend the volume before us.

* "Anthropoid Apes." By Robert Hartmann. International Scientific Series. (London: Kegan Paul, Trench, & Co. 1885.)

SOMETHING ABOUT THE INDIAN SPARROW.

(COMMUNICATED.)

YOU at home, who are accustomed to dinginess, shyness, and not overpowering twittering in your *Passer domesticus*, would be mightily astonished and amused at our sprightly and perky *P. Indicus*, which is far ahead of your bird in its familiar vulgarity and pugnacity.

Jerdon ("Birds of India," Vol. II., p. 368) tells us that "the common sparrow of India differs very little from that of Europe. It differs chiefly from *P. domesticus* in the greater purity of its colours, and in the female being somewhat paler. It is smaller, too, than its European congener."

I am not certain myself of the difference in size, but of that in plumage there is hardly a doubt, simply because our sparrow has not smoke and fog to contend with like its cockney brother, and is, therefore, always clean, and can make the most of its plumage, sombre though it be.

In one respect, the English cannot approach the Indian sparrow—and that is in its domesticity. The former, more or less, lives on man, but the latter not only lives on him, but *with* him, and this co-partnership is at times exceedingly unpleasant.

In the latter respect, the Indian is similar to what the Jewish sparrow must have been in sacred history. They must have been plentiful, for five were "sold for two farthings"; they must have frequented roof-tops, for Josephus tells us that the Temple roof was protected against birds by golden spikes; and, lastly, they must have nidified within the Temple precincts, for a young one, fallen from its nest, may have elicited from Christ the cheering words that even its accident was not without Divine knowledge and permission.

Like that sleek, black-coated ruffian, *Corvus splendens*, the Indian crow, the Indian sparrow lives upon man, and, like the crow, is never found in desolate places. As I have said, not only does he live upon man, but he lives with him; man supplies him alike with board and lodging, and, what is more, he is very particular with whom he will board and lodge. Partial to toast, he looks out especially for quarters where he will get it buttered on *both* sides.

In apparent contradiction to what I have written, he is, like the church mouse, of a religious, or rather ecclesiastical, turn of mind, and largely infests our churches, whence, from their open architecture (for the purpose of ventilation), it is impossible to exclude him.

He scandalises our services by drowning them with his deafening chirruping and scolding—nay, he chooses the most solemn moments for exhibiting his fighting tendencies. What would a curate at home say to a pair of fighting cock-sparrows suddenly alighting on the Bible as he is reading a Lesson, and then and there having it out, tooth [? B.P.] and nail, with enormous vituperation into the bargain? What would a devout worshipper say to the same encounter commencing suddenly on his bald head, and ending in his prayer-book? Out here we have to put up with their annoyances as matters of course, but the severity of the struggle can be estimated when I declare that, in some stations, these fiends contest your meals with you, picking at your bread, stealing your butter and rice, and purloining your sugar.

Drive them away, and they will perch upon your punkah ropes, awaiting a favourable moment for re-attack. The pertinacity with which they stick to their building sites is very remarkable and annoying; perhaps they have selected a spot above your study table, and you can't dislodge them; any day you may have a bushel of rubbish dropped upon you—twigs, straw, rags, &c., and every day you may pull down the nest. But in vain, hatching goes on, and then you may run the gauntlet of egg-shells, rotten eggs, or fledglings dropped upon you (*vide* note). I have known sparrows nidify above a bed, have tremendous fights on it, unmindful of its occupant, drop all the above-mentioned rubbish upon it in regular instalments, and carry their point by having the bed removed.

Such are some of the performances of *P. Indicus*, and I venture to affirm that they are never approached by *P. domesticus*. Like its British brother, our Indian sparrow has never been domesticated; it resents confinement, and resists all attempts at taming. In reality it is not worth it, for it has no voice, no plumage to attract the eye, and no accomplishments.—R. F. HUTCHINSON, M.D.

Note.—I discovered in 1858 that, during the hot weather, crows, kites, mynas, sparrows, &c., left hatching to the heat of the weather during the day, and sat at night. In those days I collected birds' eggs, and, when not at liberty to blow them, placed them in one of my office table drawers. On two occasions I heard strange noises issuing from the drawer, and, opening it, found, on one occasion, a crow, and on another a myna fledgling. I tried hard to rear both, but failed.

TWO EXTERNAL GALAXIES.—Are not the two Magellanic Clouds probably external galaxies resembling our own? If we consider the evidence this view will, I think, appear highly probable. It is clear that the star clouds of all orders are part of our own galaxy; for their arrangement on the star sphere corresponds far too accurately with the arrangement of the stars to admit of any other interpretation. We may feel just as sure that the star clouds, which are always found where stars are not, are part and parcel of the galaxy, as an insect might feel that the leaves in his tree-home which are always found outside the boughs and at some distance from their more solid parts are part and parcel of the tree to which those boughs belong. But have we not just the same sort of evidence that the Magellanic Clouds, or *nubeculæ*, are galaxies like our own, when we find that in them stars of as many varied orders of real size are combined as we find in the galaxy itself? If the insect who had learned to recognise the tree as containing parts so dissimilar as the trunk, the boughs, the branches, the twigs, the leaves, and the blossoms, were to look forth beyond the tree and to see in some distant object what resembled exactly the trunk, bough, branches, twigs, leaves, and blossoms of his tree-home, would he not be justified in concluding that that remote object was a tree like his home? Now, we have just such evidence. We have in the Magellanic Clouds every one of the features which our galaxy would present if seen from a distance. There are stars of the seventh magnitude, which we may regard as being suns like Sirius, Vega, Altair, and other stars of the giant order, removed to many times the distance of the leading orbs of our galaxy. Then there are fainter stars of all orders down to those so faint that they cannot be separately discerned with the most powerful telescopes we have, and appear only as milky nebulosity. There are star clouds of all orders; and, lastly, there are vast regions of gaseous matter akin to the great Fish-mouth nebula in Orion, and the great Key-hole nebula in the constellation Argo. If the *nubeculæ* are not external galaxies resembling our own, they present at any rate all the appearances which such galaxies would present from a very distant standpoint.

Gossip.

BY RICHARD A. PROCTOR.

FOR reasons connected with changes in regard to publishing and printing which will become apparent in the next number, the present is in some degree chaotic. Matter already in type when the changes were called for had to be employed where in the ordinary course other matter would have been more suitable.

* * *

NEXT month my Southern Star-maps will be continued, but in another form. They have not come out at all well on the black ground. I hope next month to have also pictures of Mars and Jupiter, the two planets which now present so conspicuous an appearance in our skies.

* * *

NEXT month, too, I hope to give the first of a monthly series of papers on the Face of the Sky, by "A Fellow of the Royal Astronomical Society," whose former fortnightly contributions under that heading were much valued.

* * *

BY the substitution of the word "fertility" for "futility" (at p. 133, col. 2, line 9), rather lively nonsense has been made of my remarks about the prevailing of law and the failure of lawlessness.

* * *

MY "Historical Puzzle" seems to have puzzled many in a way I should hardly have supposed possible. I have received appeals from opposite sides to reconsider my conclusion—having expressed *none*. Several proclaim their opinion that I have been most unjust to Josephus; many more consider that I have been most unjust towards the writers of the gospel narratives. Now in reality, I have only said with regard to Josephus that *if* Dr. Farrar is right in attributing to him deliberate falsification of history, by silence about matters of which he must have known if they had occurred as described by others, *then* he was guilty also of offences against literary honesty, in borrowing from the stories of those other writers, and working the borrowed material, without acknowledgment, into his professedly accurate history. As for the gospel narratives assuredly they speak for themselves; I have expressed no opinion whatever about them: those who consider that the passages I quoted from Josephus convey unsatisfactory impressions express their own feelings only. I asserted nothing of the sort. I quoted passages which are there in the book, and whose close resemblance to passages in the gospels cannot be doubted. What interpretation is to be given to the peculiarity I leave undecided—except that I put mere chance coincidence on one side as practically impossible.

* * *

THE logical absurdity of that singular sort of faith which is afraid to notice facts lest faith should be shaken, I find myself unable altogether to appreciate. Like the unconditioned it is beyond the mental grasp being in fact irrational. Don Quixote though certainly not altogether sane, submitted his card-visor to trial: that the new helmet remained untried, has generally been supposed to indicate an uncomfortable doubt lest if test were applied he would have had to make him a third helmet.

OWING to the incomplete working of a rather complex correction in proof, a passage relating to the interpolated passages in Josephus reads as if Photius were a predecessor of Origen, instead of following him by several centuries. The passage relating to John the Baptist was not inserted after Photius had dwelt on the absence of any reference to John; but the manuscript known to Photius in the ninth century, presented probably the original form of the account of the doings of Herod the Tetrarch, Aretas, Tiberius, and Vitellius. The internal evidence is so strong against the authenticity of the passage relating to John the Baptist, however, that Photius would almost certainly have regarded the passage as an interpolation, if it existed in the copy which he studied. Only, in that case he would presumably have mentioned its existence; and he does not.

* * *

I KNOW that Dr. Farrar speaks of this passage without casting doubt on its genuineness. But theologians are very poor judges, as a rule, of such matters, their wishes usually proving very fertile parents of conclusions which seem acceptable to them. The passage, without the matter relating to John the Baptist, runs thus:—

So Herod wrote about these affairs to Tiberius; who, being very angry at the attempt made by Aretas, wrote to Vitellius, to make war upon him, and either to take him alive, and bring him in bonds, or to kill him, and send him his head. This was the charge that Tiberius gave to the president of Syria. So Vitellius prepared to make war with Aretas, having with him two legions of armed men; he also took with him, &c., &c., &c.

* * *

INTO the midst of this passage, the piously fraudulent interpolator, seeing no better place wherein to drag in John the Baptist, has foisted a passage about that worthy, so ingeniously misplaced that it is *apropos des bottes* in the first place, while in the second it makes the reason for Vitellius going to war with Aretas appear to be the offence of Herod in killing John. Doubtless the interpolator had not much choice. He would have to bring in his pious fraud at the close of a section. Had he been able to pitchfork it into the middle of section I. chap. v., it might have done very well. But coming after the close of that section, (which ends with the words "president of Syria") its absurdity would strike any one except a theologian determined to find what he thinks he ought, and knows he would like, to find. "This was the charge," says Josephus, "which Tiberius gave to the president of Syria. *So*,"—the president of Syria did what he was bid. But the interpolator crams in after the charge a long rigmarole beginning "*Now*, some of the Jews thought that the destruction of Herod's army came from God, and that very justly, as a punishment of what he did against John, that was called the Baptist," &c., &c. Then, after giving the reader ample time to forget all about the order given to Vitellius, and not in the least recalling that order to the reader's mind, the narrative as improved by the interpolator, goes on "So Vitellius prepared to make war with Aretas," &c.

* * *

THE interpolator here, as in the passage relating to Christ, was a bad hand at his piously fraudulent business. Some of the ingeniously pious persons who produced epistles from Abraham, nay from Christ himself, and were ready to compose epistles by Peter and Paul, would probably have managed the interpolation a great deal better. But it must be remembered, in considering the

clumsiness of this particular rogue, that it was not quite so easy a matter to bring into Josephus's narrative persons whom either he carefully ignored or else knew nothing about. The attempt would be like trying to introduce a chasuble as part of the costume of a Roman soldier, in an ancient painting correctly presenting the warlike garb of Rome's defenders.

* * *

MR. JOHN RUSKIN has done good service in recording his opinions about Darwin, Gibbon, Kingsley, Mill, Voltaire, St. Augustine, and Grove; for though no one of any sense will accept his venom for good medicine, he has managed to set a strong black mark against the writings—nay against the whole mental and moral character—of a man not included in the list of widely-read authors whom he tries to vilify. John Ruskin *versus* Darwin is Impudence *versus* Dignity with a vengeance.

* * *

As some critics—who must be singularly keen—regard my introduction of a paragraph headed "A Positivist View of the Sermon on the Mount" as a proof that I am myself a Positivist, I may take the opportunity of remarking that I am not a lover of retrogression, and that I regard Positivism as the most retrogressive idea of religion existing, and as therefore hopelessly impossible. But indeed its history—its rise, progress, decay, and obviously approaching demise—show as much.

* * *

ALBEIT, for Comte's keenness of vision in certain directions I have a high respect.

* * *

LAST month, for reasons connected with the change mentioned above, much matter set up under my own name had to appear, or the type be distributed. A critic of the cheap sort is kind enough to suggest that much more of the number was of my writing. He regards me as identical with Mr. Clodd, with "A Fellow of the Royal Astronomical Society," with "Mephisto," and with the author of the Whist game. He also regards me as author of the notices of books. In this he pays me a fourfold compliment of a very high character. On nearly all matters which we have studied in common I think much as my friend Mr. Clodd does; but if of an envious nature, I should certainly envy him the graceful and felicitous style shown in his "Childhood of Religion" and other charming works. My friend "A Fellow of the Royal Astronomical Society," has become more widely known by his admirable letters in a contemporary than thousands who have sought fame for their own name. The Whist game in last month's number like that in the present is by one of the finest living players; and "Mephisto" achieved such success last year in triumphing over Blackburne, Mackenzie, Mason, and others, as to have made a name among the absolutely "first-best" chess players of the day. As for the notices of books the great majority were not from my pen.

* * *

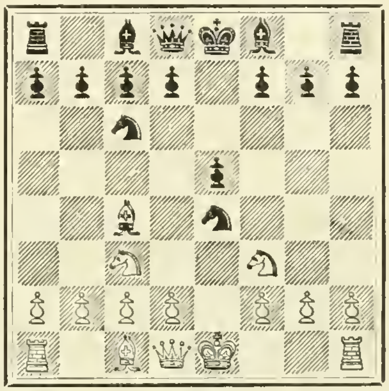
I SPEAK above of "cheap critics." A critic in *Health* appears to have taken this expression (used in the preface to my "Strength and Happiness") somewhat to himself —which is not my fault. He dwells on his objections, for the odd reason that "critics have usually treated Mr. Proctor very kindly." I admit the soft impeachment: but there are critics and critics.

Our Chess Column.

BY MEPHISTO.

EVEN among the best of Chess players there are but very few whose memory is equal to the task of retaining the different variations of each particular Opening. It would, therefore, seem to be unreasonable to expect an ordinary player to discern analogous variations in the Bishop's Opening, Two Knights Defence, Petroff's Defence, Four Knights game, &c. But we intend to make our readers acquainted with a main variation in all these Openings, without asking them to commit many variations to their memory, but simply by impressing the picture of the one principal position upon their minds.

BLACK.



WHITE.

This is a position not unfavourable to the second player, for if White now plays 5. Kt × Kt, P to Q4 follows with a fair game. 5. B × P (ch) likewise gives White no advantage, for Black replies with K × B then 6. Kt × Kt, P to Q4. 7. KKt to Kt5 (ch), K to Kt sq. 8. Q to B3, Q to Q2! 9. Kt to QB3, P to KR3. 10. Kt to R3, Kt to Kt5, &c. Black will have a better development in spite of the position of his K. White's best move is 5. Castles; this we will examine later on.

Now by bearing in mind the above position, our readers will be able to defend themselves against an attack which constantly causes the loss of many games, because it may be brought about by a transposition of moves of the various Openings we have mentioned above. To avoid future danger we will show how this position may be arrived at in these various Openings.

Bishop's Opening.	Petroff's Defence.	Two Knights Defence.	Four Knights Game.
1. P to K4 / P to K4	1. P to K4 / P to K4	1. P to K4 / P to K4	1. P to K4 / P to K4
2. B to B4 / Kt to KB3	2. Kt to KB3 / Kt to KB3	2. Kt to KB3 / Kt to QB3	2. Kt to KB3 / Kt to QB3
3. Kt to KB3 / Kt × P	3. B to B4 / Kt × P	3. B to B4 / Kt to B3	3. Kt to B3 / Kt to B3
4. Kt to B3 / Kt to QB3	4. Kt to B3 / Kt to QB3	4. Kt to B3 / Kt × P	4. B to B4 / Kt × P

White's continuation, as indicated, would be:—

5. Castles	Kt × Kt
6. QP × Kt	Q to K2
7. R to K sq.	P to Q3
8. Kt to Kt5	Kt to Q sq.
9. P to B4	P to B3
10. P × P	QP × P
11. Q to R5 (ch)	P to Kt3
12. Q to R4	B to Kt2

If P × Kt, 13. B × P, Q to B4 (ch). 14. K to R sq., and White will

have a strong compensating attack. If, for example, Black continues 14. B to K2. 15. P to QKt4, &c. Or if 14. Kt to K3 then 15. B to B6, &c.

13. Kt to K4 B to K3

and Black has the better game.

This is a safe way of defending Black's game against an attack first practised by Kiescritzky, which, through want of the proper defence, often causes the speedy loss of the game.

This is as follows:—1. P to K4, P to K4. 2. B to B4, Kt to KB3. 3. Kt to B3, Kt x P. 4. Kt to B3. We have previously shown how this position may be brought about in various ways, also that Kt to QB3 is Black's reply But supposing

4. Kt x Kt
5. QP x Kt

P to Q3 is bad, for White can now play 6. Kt x P (and if P x Kt, 7. B x P (ch) wins the Queen). 6. Q to K2. 7. B x P (ch), K to Q sq. 8, Castles, with a good game. If now Q x Kt. 9. R to K sq., followed by R to K8 (ch), &c. If, instead of P to Q3, Black plays 5. Kt to B3, White will at once get an advantage by 6. Kt to Kt5, which move would also follow upon Black playing B to B4. The only correct play for Black is

5 P to KB3

But even then Black will have a difficult game to play, especially against a stronger player. White can now proceed either by 6. Castles or 6. Kt to R4. If

6. Castles Kt to B3
7. Kt to R4 P to KKt3
8. P to B4, &c.

The attack may assume many other forms, all of which, however, may be avoided by bearing in mind the position given above, and playing accordingly to reach it.

As an illustration of the more complicated defence after Black's playing 4. Kt x Kt (instead of Kt to QB3); 5. QP x Kt, P to KB3, we append a game played last year at Wiesbaden by the veteran Chess-master, Baron van der Lasa, the esteemed compiler of the German Handbook, and the sole surviver of the seven illustrious players who, nearly half a century ago, acquired the title of the Berlin Pleiades of Chess, Baron von Heydebrand has since many years past withdrawn from active play, and devoted the attention of his leisure moments for Chess almost exclusively to the history and literature of the game—a department in which, we believe, he has no living equal.

KING'S BISHOP'S OPENING.

White. Baron der Lasa.	Black. Herr C. Beck.	White. Baron der Lasa.	Black. Herr C. Beck.
1. P to K4	P to K4	12. Kt to Kt6	P x Kt
2. B to B4	KKt to B3	13. Q x R	B x P
3. KKt to B3	Kt x P	14. B to Q3	B x B
4. Kt to B3	Kt x Kt	15. P x B	Q to Kt2
5. QP x Kt	P to KB3	16. Q to R3	B to K2
6. Kt to R4	P to KKt3	17. Q to K6	P to B4
7. Castles	Q to K2	18. P to KKt4	P to B5
8. K to R	Kt to B3	19. B to Q2	B to B3
9. P to B4	P to Q3	20. K to Kt2	Kt to K2
10. P to B5	P to KKt4	21. P to B4?	P to R4!
11. Q to R5 (ch)	K to Q	22. B to B3?	R to R3!

And White resigns.

Our Whist Column.

GAME II.

THIS game, like the game which appeared last month, is by that Whist-master, Mr. F. H. Lewis, as are the notes. The games admirably illustrate the arguments for and against Whist signalling. In last month's hand a player seeing the importance of leaving the adversary in the dark, omits the conventional indications with regard to his hand and thereby saves the game. In the present hand, B's unfortunate signal gives the game to the enemy.

THE HANDS.

B { H (*trumps*). Q, Kn, 9, 6, D. K, 9, 5. S. 8, 5. C. A, Q, 10, 7. }

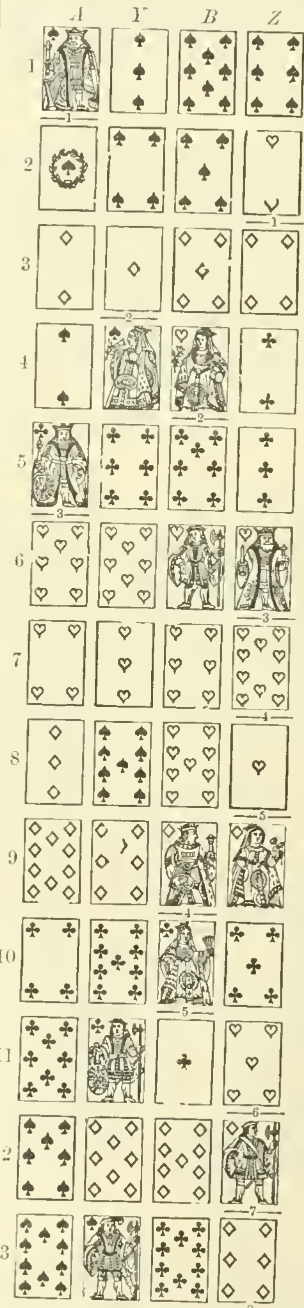
Y { H (*trmps*). 8, 3. S. Q, Kn, 9, 4, 3. D. A, 8, 7. C. Kn, 9, 6.

[B / Y Z / Tr. H. 10. / A leads.]

Z { A, K, 10 5, 2. 6. Q, Kn, 6, 4. 5, 3, 2.

A { H (*trumps*). 7, 4. S. A, K, 10, 7, 2. D. 10, 3, 2. C. K, 8, 4. }

Score:—A-B, 2. Y-Z, 3.



NOTES TO GAME 2.

NOTE.—Card underlined takes trick, and card next below leads next.

1. *B*, who has justifying strength in trumps, and, with his partner's lead, a beautiful hand, commences a call; he does not wish to be forced.

2. As the call is developed, *Z* properly gives no information, but trumps with his lowest.

4. *Y* plays Spade Queen in the hope of giving *Z* a discard. *B* is in difficulties. The ten having been turned, he must trump with an honour. He selects a false card, but *Z* is in a position to recognise it as such, having himself the two commanding honours. He, therefore, most wisely discards.

5. *B* having been left in possession of the trick, cannot continue a trump. If *Z* was playing truly his Knave is apparently safe. He therefore opens his strong suit.

6. *A*, who is not in a position to form an adequate judgment, obeys his partner's call, and leads up to destruction. *B* must play the Knave having reference to the turn-up card.

7. *Z* properly continues the trump, and, no player having failed, is in a position to exhaust *B*'s trumps.

9. *Z* now continues his own suit, and with the long trump is enabled to bring in the long Diamond and win the game.

The game is an instance of legitimate information being more advantageous to the adversary than to the partner.

Next month the first of two important papers by "Mogul" on "Leading at Whist," will appear in our Whist Column. We hope also to have his permission to publish with that first paper a series

of Whist hands which he has suggested as tests of the methods of leading likely to be followed by good players. Nothing can be better than to deal with tests of this kind: because, in considering what one would do in a test case, and noting what other players would do, one learns the true principles which should govern Whist in actual practice, depending as this does largely on the consideration of what other players are likely to do.

A remark of mine (as "Five of Clubs") about a rule touched on by "Pembridge" in regard to not leading from a long weak suit without re-entering strength, has been misapprehended by the able Whist-editor of the *Australasian*—though the fault is certainly my own. I spoke of the rule "laid down by 'Pembridge'" when I ought to have said the rule "stated" by him.

Recent Inventions.

[The following paragraphs were left standing when the last number of weekly Knowledge came out, and appear now owing to the change in publishing and printing arrangements. We do not propose to continue the description of recent inventions, which are unsuitable to Knowledge in its monthly form.]

GRACE'S PATENT EPICYCLIC ELLIPTOGRAPH.

[Patent, No. 4,582].—The Epicylic Elliptograph (Fig. 1) consists of a cross frame, O, supported by uprights at each end, carrying at the centre the operating handle G, and the mechanism: which is such, that while the handle, G, by means of a central pivot, gives the inner arm, H, attached to it underneath, any given angular motion in either direction, the wheel-work C D E F A R S S' B, by means of a cannon pinion attached to the wheel F, and fitted round the central pivot, gives the outer arm, L, an equal angular motion in an opposite direction, which causes the pen, M, fitted on the outer arm, L, to move in an elliptical path.

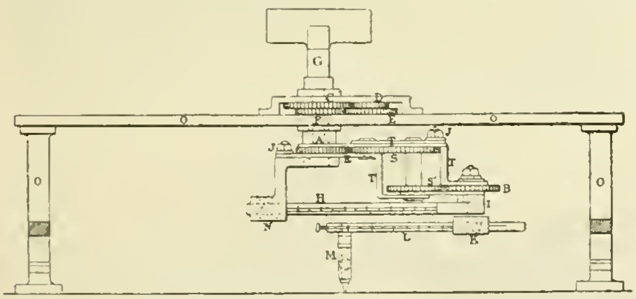


Fig. I.—Grace's Epicyclic Elliptograph, for describing ellipses of various sizes and proportions, from a point upwards. Relative diameters of the wheels:—A = 3; D = 1; E and F = 2; A R and S = 2; S and B = $2\frac{1}{2}$.)

It can be set to describe ellipses of any given proportion, from a straight line to a circle, and of any size, from a point up to twenty inches by ten inches and over, by varying the length of the inner arm, H, and the outer arm, L, by means of the fixing-screws J K and N, and the graduated scale on the arms, so as to make the inner arm, H, equal to one quarter the difference between the major and minor axis of the required ellipse, and the outer arm, L, equal to one quarter of their sum, or vice-versâ, the inner arm, H, can be made equal to one quarter their sum, and the outer arm, L, equal to one quarter their difference. And after adjustment for the given size and proportions, the required ellipses can be drawn, with their axes, at any convenient angle with the cross frame O.

It is also made so that pairs of equal change-wheels of various sizes can be fitted; one on the under end of the cannon pinion of wheel F, and the other on the up end of the pivot I, to vary the length of the inner arm, H, instead of the permanent jointed frame and wheels, T T; and, by altering their relative size, the instrument can be used to describe various symmetrical curves and scrolls for ornamental purposes.

The principle of the motion of the above elliptograph and its adjustment can be proved mathematically.

The elliptograph, having only a single cross-frame, is of smaller relative size than the elliptographs constructed on the trammel principle, which require a double cross-frame, equal in length to the difference between the major and minor axes of the most elongated ellipse they will describe, and it also requires a simpler movement of the handle to operate it.

The elliptograph, with or without change-wheels, can be obtained of Mr. Harling, 40, Hatton-garden, E.C.

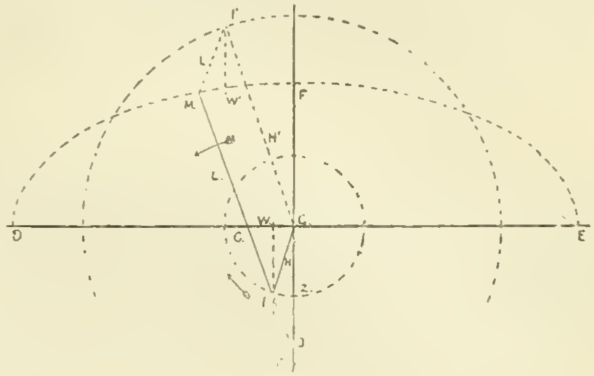


Fig. 2.

Proof.—In Figure 2, let M I = the outer arm, L, of the elliptograph, and G I = the inner arm, H. Let D E = major axis and F O = the minor axis of any ellipse, and let M I be produced to meet the minor axis, F O, in the point B. Let the vertical line, I W, be drawn perpendicular to the major axis, D E, and the horizontal line, I Z, be drawn perpendicular to the minor axis, F O. Then, as by the construction of the above epicyclic elliptograph, angle C I W always equals angle I G Z, and the angle W I G also equals the alternate angle I G Z, consequently the angle W I G equals the angle C I W, and, therefore, the right-angled triangles G W I and C W I, having the side W I in common, are similar and equal, and the hypotenuse C I, equals the hypotenuse I G: and it will be seen that the right-angled triangle C W I is similar and equql to the right-angled triangles I Z G and I Z B, as both the angles, I G Z and I B Z, equal angle C I W, and their side, I Z, being equal to side W G, is also equal to side C W. Therefore, their hypotenuses, viz. the lines or part, I G – I G and I E, are equal in any position of the line or arm, M I, produced, and consequently the point C is always on the same straight line as G W produced, viz. the major axis E D, and also the end or point B is always on the line G Z, produced, viz. the minor axis, F O, produced or otherwise, as the right angles of the pair of triangles are adjacent. And as, by the principles of ellipses, any point M, on part B C, produced beyond C on the major axis, will describe an ellipse, therefore, as part I M represents the outer arm of the above epicyclic elliptograph, the extremity of the outer arm, L, of the above epicyclic elliptograph will describe an ellipse. And as from the principles of ellipses the part C B must equal the difference between half the major and minor axes of any required ellipse, and as from above the parts I C, I G, and I B are equal, therefore C B, or $\frac{1}{2}$ (major – minor axis) equals the two parts, C I and I B, and is, consequently, equal to twice I G, and consequently I G, viz. the inner arm of the above epicyclic elliptograph, equals half of half the difference between the given major and minor axes: that is, one quarter the difference between the major and minor axes, which is according to the rule for setting the inner arm, H, of the elliptograph. And, also, as I G equals $\frac{1}{4}$ the difference between the given major and minor axes, and as I G = I B, therefore I B equals $\frac{1}{4}$ the difference between the given major and minor axes, and as the whole line, M B, by principle equals half the major axis, therefore the part I M, viz. the outer arm, L, of the above epicyclic elliptograph equals $\frac{1}{2}$ major axis – $\frac{1}{4}$ (major – minor axis) = $\frac{1}{2}$ major – $\frac{1}{4}$ major + $\frac{1}{4}$ minor axis, viz. $\frac{1}{4}$ (major + minor axis) which is also according to the rule for setting the outer arm, L, of the above epicyclic elliptograph. And from the above proof, showing that with the outer arm M I = $\frac{1}{4}$ (major + minor axis) and the inner arm I G = $\frac{1}{4}$ (major – minor axis), and the angle C I W always = angle I G Z, any point M on C M will describe an ellipse. It can also be shown that if the inner arm H', viz., G I', be made = $\frac{1}{4}$ (major + minor axis) and the outer arm L', viz., M I', is made = $\frac{1}{4}$ (major – minor axis), the point M on the shorter outer arm M I' will also describe a similar and equal ellipse. Let the longer inner arm I' G be drawn parallel and equal to the longer outer arm M I in any position as given above; then if the end M I' and I G be joined, M I' G I will be a parallelogram, and the side I G will represent the shorter inner arm as given above, and it will be seen as follows that the shorter outer arm of the above elliptograph, viz., M I', being set equal to the side M I' of the parallelogram M I' G I will also coincide with it.

For M I produced being drawn parallel to I′G, the angle I B Z will equal angle I′G F, and, as shown above, angle I B Z equals angle I G Z, therefore angle I′G F equals angle I G Z; and as, by the above description of the motion of the elliptograph, the whole angle C I G or M I′G is in any position twice the equal angles I G Z or I′G F, consequently the angle C I G equals the angle M I′G, and therefore the shorter outer arm M I′ being set equal to the shorter inner arm I G will also coincide with the side M I′ of the parallelogram M I′G I, and its end M with the end of the longer outer arm I M in any position: and, as shown above, the end M of the arm I M will describe an ellipse, therefore the end M of the shorter outer arm M I′ will also describe a similar and equal ellipse.

ELECTRIC BURGLAR ALARM.

[Patent No. 13,525. 1884.]—In this invention by H. C. Roome, Jersey City, U.S.A., each building or structure to be guarded is connected electrically with a differential galvanometer or relay electro-magnet at a central office. The galvanometers or relay-magnets are normally balanced by resistances in the office equivalent to those of the external circuits, and should the resistance in any external circuit be varied by an attempt to open a window or door, &c., the galvanometer or magnet in the circuit completes the circuit of a relay for raising an alarm in the office. Mechanisms are placed in the office and in the external circuits and actuated by increasing the current, to introduce corresponding resistances into the external and office circuits at intervals, with the object of preventing any person from obtaining a knowledge of the resistance in circuit. The galvanometers or relay-magnets are cut out of circuit while the resistances are charged to prevent a false alarm, due to the resistances not being introduced simultaneously into the two circuits, and the battery power for effecting the charge is at the same time introduced by a compound key. One resistance-charged mechanism may be employed at the office to charge the resistance in any number of alarm circuits by replacing it by rheostat resistances after the resistance in any circuit has been charged. When the door, &c., of any guarded structure is opened, part of the resistance in its circuit is short circuited, thus giving alarm, and the short circuit is maintained by a short circuiting mechanism in the external circuit, even should the door, &c., be closed again. The short circuiting mechanism may be shunted out of circuit by an electro-magnet excited from the office. Electro-magnetic apparatus is provided for giving alarm when the battery becomes inoperative. This invention is somewhat related in principle to our system of fire-alarms introduced by Sir Charles Bright. It is ingenious and not very complicated, but its adoption would involve the laying or erection of a new system of wires—a serious objection in English towns.

ORNAMENTING GLASS.

[Patents Nos. 12,901 and 12,902. 1884.]—The object of the first of these patents, by J. Budd, 3, Finchley-road, Surrey, is to impart to sheets of glass the appearance of marble, malachite, onyx, or other stone, for use in the decoration of ceilings, &c. A tank is partially filled with a mixture of one part by measure of lime with two parts of water, and any ordinary pigments mixed with oil and of the tints desired are floated on the mixture. Any other mixture capable of floating the colours may be employed. The glass, prepared or not with gold size or other suitable drying material, is laid on the floating colours, which are thereby transferred to the glass. The veined or ornamented surface is then painted to form the ground, is coated with a mixture of shellac and plaster-of-paris or other backing material, and when dried is ready for use.

The second patent embraces a device for imparting to glass surfaces the appearance of mosaic work and the like, such as designs upon tiles, &c., chiefly for the decoration of ceilings, &c. The paste obtained by boiling down an aqueous solution of one part strontium nitrate with two parts of ordinary starch is applied both to the glass and to a paper lithograph of the design to be produced. The paper is then laid on the glass and the surplus paste squeezed out. The glass is dried, and the paper is reduced to a very thin film by sand-paper or the like, and spermaceti or paraffin wax is applied to form a protective coating and to impart lustre. The glass may also be veined or grained.

HANGING AND DRAWING CURTAINS.

[Patent No. 8,863. 1884.]—In this invention by J. Turner, 76, Hyde Lane, Hyde, Cheshire, the curtains are attached to tapes which are suspended by connecting to eyes cast into the balls sliding in a hollow or grooved pole, the eyes projecting downwards through a slot. Cords passing over pulleys through central holes in the balls, and crossing at the centre, are brought down at the side and may be suitably secured. The inner balls are fast to the cord, the outer ones to the pole. By pulling either cord, as the case may be, the curtains are drawn or withdrawn.

LARYNGOSCOPE.

[Patent No. 10,849. 1884.]—A. H. Vesey, 8, Upper Bedford-place, W.C., has patented this instrument, in which a small incandescent electric lamp is partially imbedded in some non-conducting material, as cement, contained in a casing which is fixed by a bayonet joint within a tube lined with insulating material, to which is attached a German-silver tube of small diameter, containing the wires conveying the current. On the silver tube slides a piece carrying a rod with a mirror at one end, so that the light may be reflected as desired. At the end of the tube is an ebonite handle, containing a switch and resistance coil, so that the strength of current may be regulated. The connecting wires project from the end of the handle, and are connected to a battery.

LONDON INSTITUTION.—Two lectures were delivered by the Editor of KNOWLEDGE at the London Institution on Feb. 18 and Feb. 25, the subjects being "New Stars" and "Volcanoes." There is a greater connection between these subjects than might at first sight have been supposed. Mr. Proctor showed that new stars indicate disturbances in our stellar system akin in character to volcanic disturbances in a planet. They are casual or accidental phenomena, and do not belong to steady life-processes. He showed that new stars occur in unfinished regions of our galaxy, in star clouds, star clusters, regions of star mist, &c., as is shown by coincidences altogether too numerous and too striking to be accidental. (In passing he presented the thought that the Magellanic Clouds really may be external galaxies—or else outlying parts of our own galaxy.) In dealing with volcanoes, he showed that they belong to the astronomical at least as much as to the geological aspect of earth-study. He found in the moon evidence of volcanic action such as took place in the past on the earth, the traces having however been removed. He traced comets to volcanic action in terrestrial planets, in giant planets, and in the suns which people space.

CONTENTS OF No. 4.

SPECIAL NOTICE.

KNOWLEDGE *in future will be published by* MESSRS. LONGMANS, GREEN, & CO., 39, *Paternoster-row, London, E.C.*

TERMS OF SUBSCRIPTION.

"KNOWLEDGE" as a Monthly Magazine cannot be registered as a Newspaper for transmission abroad. The Terms of Subscription per annum are therefore altered as follows to the Countries named:—

	s.	d.
To West Indies and South America	9	0
To the East Indies, China, &c.	10	6
To South Africa	12	0
To Australia, New Zealand, &c.	14	0

To any address in the United Kingdom, the Continent, Canada, United States, and Egypt, the Subscription is 7s. 6d., as heretofore.

KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART

LONDON: APRIL 1, 1886.

THE UNKNOWABLE.

By Richard A. Proctor.

SUN-WORSHIP.

The Sun as God of the Year.

BUT if the glory of the rising sun, the manifest power of the sun by day and the seeming conflict of nature attending the sun's daily departure, moved men of old times to adoration and to sacrifice, how much more, in a more advanced age, must men have been moved by the annual career, the alternate defeat and victory, of the great sun god! We are so accustomed to the progress of the year, we watch with such complacency the steady alternations of the seasons, that we find it difficult to imagine the sensations with which men in past ages must have watched the gradual fading of the sun's influence as summer merged into autumn and autumn into winter. Whether the decline of the sun towards eventide was ever watched with anxiety we cannot know, but we can judge with considerable probability that it was not. For, however far back we trace the ideas of man, we always find the day measuring but a very small portion of each man's experience in time. Even before man in the lowest form of savagery existed, the day was recognised—unconsciously in those times, but not less really—as a short time-measure. The Gibbon ape, which welcomes the rising sun with noises and gestures of gladness, is not concerned when the sun is setting, though he and all creatures which show consciousness of the value of the sun's light and warmth at all, are troubled when the sun disappears in eclipse. If we could imagine man created suddenly *as* man, with no past experience through thousands of generations to guide him, we might regard as conceivable the anxiety described in Blanco White's well-known sonnet:—

> Mysterious night! When our first parent knew
> Thee from report divine, and heard thy name,
> Did he not tremble for this glorious frame,
> This wondrous canopy of light and blue?

As we might also conceive that imagined first man's wonder when

> 'Neath a curtain of translucent dew,
> Hesperus and the host of evening came,
> And, lo! creation widened on man's view.

Though we can hardly imagine the first man asking himself

> Who could have thought such darkness lay conceal'd
> Beneath thy beams, O Sun! or who could find,
> Whilst fly and leaf and insect stood revealed,
> That to such countless worlds thou mad'st us blind?

For even the wildest dreamer has not imagined that a first parent, besides being instructed in the names of all living creatures, had also received, on the first day of his life, such instruction in astronomy as would make the nature of the orbs of night clear to him. If he had, he would have been able to view with considerable complacency the departure "of the great setting flame," though he would also, I conceive, have been so sadly wearied that he would probably have been asleep almost ere the last ray of sunlight had disappeared.

Nor again, can we imagine that man, even in his earliest savage days, would have watched with very great anxiety the gradual falling off in the light of the moon, as day passed after day, from the time of full moon till the moon was lost altogether in the light of the sun. Possibly so soon as men began to watch the moon more carefully than of yore, anxieties may for a time have arisen each month, despite the long experience of lunar changes the race had already had. It would seem from the signs of rejoicing—the blowing up of the trumpet in the new moon—with which the Jews welcomed the moon's return, long after they had ceased to offer sacrifice to her as to a deity (only retaining an old ceremonial because it could not conveniently be dropped), that for a time in the history of each race an occasion for prayer and sacrifice, lest the moon should *not* return, had been recognised. Yet it is difficult to put ourselves in the position of races so childlike as to be afraid lest the waning of the moon meant her approaching decease.

But it is very different with the varying glory of the sun as ruler of the year. It requires very little effort to picture to ourselves the intense anxiety with which the sun's waning power in autumn must have been observed in the earlier days of agriculture. We may well believe that in still earlier times the gloom of winter inspired terror. But it must have been in the period of transition from the state of complete ignorance about the sun's annual motion to the time when the laws of his motion around the celestial sphere came to be clearly known, that men's anxiety lest the sun was actually departing altogether, when each autumn he sank day by day further south, must have been most fully developed.

Observe that in those times men would have thought nothing about the sun's circling motion round the star sphere. The circling daily motion around the sky they could not but notice. But the circling annual motion round the star sphere they would fail to recognise. Not one man in a hundred even now has clear ideas on this point, even if he knows the general teachings of astronomy. In the early days of agriculture all that men would notice would be that, after shining in glory high in the heavens at midday, and for a much longer time than he was below the horizon, the sun's power seemed to be declining. Shorter and shorter became the duration of his daily glory, less and less the fullness of the power attained when day was at its height. As this went on (during a period which to the child-man would seem very long indeed) doubt would be followed by anxiety, anxiety would be replaced by dread. It would seem a time for propitiation and entreaty. Sacrifice must be offered to the powers by which the sun-god seemed to be assailed and before whose continued assaults he seemed to be yielding. Nay, it would become a most solemn duty on the part of all the members of the community to join in prayer, in entreaty, in sacrifice. The man who did not afflict himself at that time would offend against the community, seeing that the sun-god whose return was longed for, or his enemies whose withdrawal or defeat was to be secured by sacrifice, might possibly fail to respond to the prayers and offerings of the people if even one single member of the community seemed careless in the matter. The same superstitiously selfish feeling which even in our own day manifests itself (as when men grow angry with those

who recognise no Sabbath duties) would move the community to excommunicate, nay even to slay, the man whose soul was not duly afflicted when the sun-god was apparently deserting the people.

We can understand, again, with what alternations of fear and hope men would watch in those days the gradual diminution of the sun's rate of retreat. The approach of the solstice—or staying of the sun—would be a matter of no mere dry scientific interest, but moving all to earnest anxiety. As it gradually became clear to them that the sun's retreat would shortly be stayed, hope would grow more and more in their breasts. But what a time of hope, what a promise of salvation would there be when at last the sun's down-sinking was actually stopped, and observation showed that the sun-god was preparing to resume his glory!

Three or four days after the winter solstice the new birth of the sun-god would be made manifest. What in after years would be selected as an appropriate day to mark the (in truth, unknown) date of the birth of a Saviour of another kind—December 25, or thereabouts—would be the time when the Sun-God of earlier times was fully recognised as re-born. His birth on that morning, the day-spring and the year-spring combined, would be a time of peculiar solemnity, yet not to be marked either by sacrifice or propitiation, seeing that neither would fears then predominate over hope nor hope over fears. When he rose in the east (I am speaking of a time 3,000 years before the Christian era) the Virgin Constellation, with arms outstretched as if to receive him, was sinking in the west. As the Buddhist sun myth put it, the Virgin-Mother Maia paled before the growing glory of her son.

We can picture, too, the growing hopes with which the progress of the sun-god would be watched, until at length, day becoming equal to night, his triumph over the powers of darkness was assured. This, with the worshippers of the sun (and probably every race the world has yet known has, in a certain stage of its progress and for many hundreds of years, worshipped the orb which is our life as well as our light), would have been the veritable Passover of their God. On one side of the equator he was still shorn of his beams, as Samson (whose name implies that, like Herakles, he was a sun-god) was shorn of the flowing locks by which the solar rays were typified. For till the vernal equinox the hours of darkness are longer than the hours of light, but in crossing the equator the sun may be said to break through the bonds which have restrained him; his power is now declared; he has at length overcome his opponents; he rises from his wintry tomb.

If any doubt could remain that the Passover, whatever meaning free from Nature-worship Jewish legislators subsequently assigned to it, was originally a solar festival glorifying the Passover of the Sun-God, and later typifying the Crossing and Resurrection of Thammuz, it should be removed when we consider the significance of the association of the moon's movements with those of the sun in determining the time of the Passover, and with us the occurrence of Good Friday and Easter Sunday. However natural it may seem to the theological type of mind that an angel of destruction passing by marked doors on a special night should have started the remarkable observances of the Paschal feast, and again, however obvious it may seem to such minds that when Easter, with its Christian significance, came to be established, the Jewish rules for determining the time of the Passover should be adopted by Christian communities, it would in reality be altogether perplexing to reasoning minds that Jewish and Christian peoples should let the sun and moon define for them the dates of their most important feasts. It is simply inconceivable that if the slaughter of the Egyptian firstborn—poor little wretches, most of them—had marked the real beginning of the festival, the Jewish legislators, struggling as they had to do against a constant desire on the people's part to return to the worship of the sun and moon, should have decided—in the midst, too, of toilsome and dangerous journeyings—to fix the festival by observation of the sun and moon, and to consecrate it by observances strongly suggestive of sacrificial offerings to the sun and moon as deities. The return of the sun to power after a term of weakness, his victory after defeat, and the accompanying glory of the full moon, would assuredly have been regarded as very appropriate occasions, alike among the Egyptians and among the Babylonians,* for sacrificial observances. But such events as the massacre of the firstborn of Egypt, and the sparing of the firstborn of Israel, would not naturally be commemorated by a movable feast at all, and assuredly would not have been associated with ceremonies so suggestive of sun-and-moon worship. The difficulty of assigning any actual date to the events which Good Friday and Easter Sunday are intended to commemorate might perhaps justify the Council of Nice in definitely ruling that they should be determined by reference to a Jewish festival. The Council of Nice consisted of theologians, and would naturally enough fall into such a course, even while leaving Christmas-day a fixed feast. But those who are not theologians may be permitted to look farther back for the real origin of arrangements so specially astronomical as those by which Passover and Easter are determined, even if they do not recognise in Christmas the birth of the Sun-God, and in later festivals the modified records of the annual Crossing, Return to Power (or Resurrection), and Ascension of the orb worshipped at one stage of development or another by every race which has passed from savagery to civilisation.

That the progress of the sun from the equatorial crossing (risingly) towards the summer solstice, was regarded as the Ascension of the Sun-god, may be recognised even in the use of the astronomical word Ascension. For the right ascension of the sun (as of other heavenly bodies) is even now measured from this very crossing-place. Whether it be a mere coincidence or not, the facts remain, that regarding the winter half of the year (as we know some worshippers did regard it) as the time of the death of the Sun-god, his resurrection followed his crossing of the equator, and he advanced thence towards his glory and ascension (even astronomically defined as such). And after all, if we thus associate Christian festivals with sun-worshipping ones, formerly regarded as altogether sacred, we are only recognising in these special cases what has been recognised in multitudes of others—that pagan ceremonials retain their influence, their dates, their ceremonial, and even their associations, ages after pagan beliefs have passed away.

Here again, as in dealing with the morning and evening sacrifices originally offered in honour of the rising and setting god of day, we find that we cannot easily understand the offerings made at the time of the Passover as being seriously considered to be pleasing to Deity itself. The smoke from the fire which consumed burnt offerings, rising into the air and losing itself in the sunlit sky, might very well seem to sun-worshippers to be likely to please their god, supposed to be just a little above the heights to which the worshippers could themselves attain. The smell of the proffered food would be of a sweet savour to *such* a god. But to imagine that God, regarded as the creator of the whole universe, could be

* It is hardly necessary to say that nearly all the ceremonial observances described in the Pentateuch may be regarded as probably, if not certainly, belonging to much later times than they are associated with by the ill-informed.

pleased with such sacrifices, is in itself an idea about as near to blasphemy as any imagination of man's could well come—a truth which was very clearly perceived by the later teachers of the Jewish people, who speak with appropriate warmth of the insult to God which the idea of His being pleased with sacrifice assuredly involves.

Regarded in their natural sense, such passages as are emphasised in the following would be almost revolting; but, regarded as symbolical, they appropriately suggest recognition of the glory, might, and beneficence of the sun as emblems of the qualities men ascribe to Deity:—

"And in the first month, on the fourteenth day of the month, is the Lord's Passover; and on the fifteenth day of this month shall be a feast: seven days shall unleavened bread be eaten. On the first day shall be an holy convocation, *ye shall do no servile work*; but ye shall offer an offering made by fire, *a burnt offering unto the Lord; two young bullocks, and one ram and seven he-lambs of the first year*: they *shall be unto you without blemish*; and their meal offering *fine flour mingled with oil*: three-tenth parts shall ye offer for a bullock, and two-tenth parts for the ram: a several tenth part shalt thou offer for every lamb of the seven lambs: and *one he goat for a sin offering to make atonement for you.* Ye shall offer these beside the burnt offerings of the morning" (the risings of the Day God and Year God were combined at this season), "which is for a continual burnt offering. After this manner shall ye offer daily, for seven days, the food of the offering made by fire, *of a sweet savour unto the Lord*; it shall be offered beside the continual burnt offering, and the drink offering thereof. And in the seventh day he shall have an holy convocation; ye shall do no servile work."

All this would be very suitable at the return of a Sun God, who, if not welcomed with due rejoicings, and by such cessation from labour as only *such* a God can be supposed to desire, might go back again; precisely as the fast of the atonement six months later was very suitable at the seeming decay of the same God's power, who unless helped by lamentations and mourning might go out altogether. But all such observances have no fitter reference to the worship of an Almighty Omnipresent Being than the battering of pots and pans with which lower savages strive to arrest the departure of the sun in eclipse, or welcome his return soon afterwards (in response, as they believe, to their disturbances).

It is, however, when we consider the planets that we find the most curious evidence in regard to the old forms of worship.

COAL.

By W. Mattieu Williams.

THE ORIGIN OF COAL SEAMS.

IN the summer of 1855 I took a walk from Munich to Venice, and on my way through the Tyrol came upon a lake practically unknown to tourists, the Achen See, which lies nearly due north of Schwaz, about thirty miles from Innspruck, quite away from any of the main roads usually followed. It is an oblong basin, a depression of the Achen Thal, bounded by steep and densely-wooded mountain slopes. The water is unusually colourless and clear—so clear that taking a header from a steep bank into its depths was quite a sensational exploit; it appeared like a suicidal plunge over a precipice into thin air.

It was a hot day in July, and I accordingly revelled in a long swim. Looking down into the clear transparent water below me, I was surprised to see a subaqueous forest increasing in density as I proceeded farther and farther from the shore. There were trees standing quite upright, trees lying down, and trees leaning at every angle between the perpendicular and horizontal. I was alone, and my only means of further exploration was by diving. Where the trees were thickest it was too deep for this, but nearer the shore I was able to reach the bottom and bring up some of the soil, which proved to be a loamy powder of grey colour speckled with black particles of vegetable matter, apparently consisting of scaly fragments of bark and leaves. I brought up several twigs and small branches, and finally, after a few struggles, succeeded in raising a branch nearly as thick as my arm and about 8 feet long. The difficulty of raising it was caused by the greater part of its length being buried. This I brought ashore to examine at leisure.

The bark was entirely gone, the wood very dark, and the annular layers curiously loosened and separable from each other, like the layers of an onion. This looseness gradually diminished as I stripped off successive rings, and when the stick was thus reduced to about half its original thickness the wood became so compact that I could strip it no further. It appeared to be a branch of oak, and had become so completely saturated with water that it sank rapidly.

My walk from the north end of the lake to its southern extremity—*i.e.*, along its greatest length, about five miles—was always near to the water's edge, thus affording a complete panoramic view of its surroundings. This supplied a satisfactory explanation of the source of the great accumulation of trees in the lake. Here and there were long bare gaps breaking the continuity of the steep wooded slopes. These long alleys of denuded ground extended from above downwards, and had evidently been stripped of their trees by torrents, or landslips, or some such action. They were the tracks of vegetable avalanches, as shown by the uprooted trees that had escaped the general down-sweep, and were lying by the sides of the tracks. This theory of vegetable avalanches was confirmed by inquiries I made at the village near the southern end of the lake.

In 1856 I walked through a large part of Norway, and there was reminded of the Achen See by observing on some of the more precipitous shores of the fjords the tracks of tree avalanches. They are well seen in such parts of the great Sognefjord, the main trunk of which runs 120 miles inland, and its branches collectively add about another 120 miles to this. They are still more remarkable on some of the fjords further north, such as the Storfjord and its magnificent branches, the Slyngsfjord, the Sunelvsfjord, the Nordalsfjord, and the Geirangerfjord, now made easily accessible to tourists by the excursion steam-packet from Stavanger.

When I visited these in 1874 the tracks of vegetable avalanches were very numerous: two had come down during the last winter, and one in the previous October. The latter destroyed a boathouse and boat, and one of the others came within twenty yards of some farm buildings. As we passed, seeing it from the middle of the fjord, the track appeared nearly in contact with the house. They are so frequent hereabouts that the hardy mountaineers, who cultivate their little freeholds with that pertinacity and productiveness only known where the worker is the freeholder, display very sound dynamical foresight in selecting the sites of their houses. They build them on protrusions of the rock, which deflect the torrent when it descends against it. On rare occasions the shock is too much for the knob of rock, and it is swept down also. Such was the case in 1735, when the church of Slyngstad and many houses were destroyed.

The present agency of man is tending to diminish the magnitude of these vegetable deposits—trees are cut down for house-building, for fuel, and for exportation During only the present geological epoch, while these fjords and their wooded slopes have existed as they now are, countless millions of large trees must have thus been swept into the deep water in latitudes of most unfavourable climate for luxuriant vegetable growth, where there are but three or four months of growing summer time in the year.

What has become of all these? Remembering that the mountain slopes on which they grew continue downward at about the same angle below water as above, and thus extend to great depths, reaching in many cases to more than a thousand feet, it is evident that the stony matter, the gravel, the ground and splintered rock, will be deposited under water *at the foot of the slope*, while the trees launched forward by the impetus of their fall must float towards the middle of the estuary, there loiter and linger, and drift afloat until they become saturated with water, and then will sink to their final resting-place at the bottom of the fjord, which they will cover with some rude approach to uniformity, but thickening towards the middle, if the bottom slope is considerable.

The water of these fjords, and of such lakes as the Achen See, is remarkably clear and free from sedimentary matter, excepting at the mouths of the rivers that enter the terminations of their minor branches. Thus the tree deposit must consist of nearly pure vegetable matter, soddening, softening, and settling down century after century, during thousands and thousands of years, forming of necessity some kind of coal.

The difficulty that I have already pointed out as presented by the small quantity of mineral ash in coal does not here present itself; no soil is demanded for the formation of such a deposit as this. All the soluble mineral matter in the original plant material, such as the potash salts, would be washed out, and the only other material likely to take its place would be the very small quantity of impalpable particles that exist invisibly even in water that we call clear. Such is the actual composition of the mineral ash of most of our coal. Potash is nearly absent, and the material of the impalpable powder remaining behind when the coal is burnt completely is of about the same composition as the shaly strata above and below and beyond the coal seams.

Our coal seams occur in the form of basins and oblong troughs, *i.e.*, the form of lake and fjord bottoms; those who have specially studied the matter agree in regarding the material of coal as vegetable matter that has long been subjected to the action of water. As an example of the shape I quote the following description of our great northern coal-field by Hull ("The Coal-Fields of Britain," page 253): "Recent observations have tended to confirm the opinion that the structure of this coal-field is that of a trough, or irregular basin, of which the longer axis lies in a north and south direction, stretching from the apex near the mouth of the Coquet, through North Seaton and Yarrow collieries on the north of the Tyne, and through Monkwearmouth Colliery below the magnesian limestone to the south of that river." I might quote a multitude of similar descriptions of other coal-fields. On page 72 of the above-quoted work, Hull says:—"There can be no doubt that the laminated structure (of coal) is the result of accumulation under water, and Bischof adopts this view upon other considerations. He says: 'The conversion of vegetable substances into coal has certainly been effected by the agency of water.' The same great authority believes that coal has been formed, not from the dwarfish mosses, sedges, and other plants, which now contribute to the growth of our peat-bogs, but from the stems and trunks of the forest trees of the carboniferous period."

The fossils associated with coal are generally estuarine, sometimes marine, and occasionally lacustrine. As I am pleading for my own theory, I will quote again the same writer (page 66), who writes without any knowledge of my observations. He says:—"The coal seams are associated with strata deposited under water, and all recent investigation strengthens the probability that the water was *generally estuarine, sometimes marine*." He then specifies and describes the particular fossils, such as *Goniatites*, *Aviculo-pecten*, *Orthoceras*, *Spirifer*, *Productus*, &c. He tells us of *Unios*, *i.e.*, fresh-water shells, found in the same stratum with marine *Modiola* and *Aviculo-pecten*, and the little coiled shell *Microconchus carbonarius*, which has puzzled able palæontologists, some having supposed it to be a coiled *Serpula* or *Spirorbis*. Also a minute crustacean abundant in coal shales, and supposed to have belonged to the fresh-genus *Cypris*, but is by some supposed to be a marine creature of the genus *Cythere*.

Here as in other descriptions I find a palæontological paradox, a puzzling confusion of marine, lacustrine, and estuarine creatures, that have sorely exercised the ingenuity of skilful palæontologists.

The great fjords of Norway, which for reasons I shall further discuss presently, may be regarded as typical of the configuration that prevailed during the carboniferous period, afford a key to this dilemma. The magnificent Hardangerfjord is still larger than the Sognefjord. There were no steamers there at the date of my first visit, and consequently I did much boating on it. One hot day, when on one of its terminal branches, the Sörfjord, I was surprised to see the boatman dip a tin can into what appeared sea-water, and drink it freely. I did the same, and could distinguish no salinity. Yet on the rocks close by there was bladderwrack (our familiar brown seaweed, that is buoyed by little blister-like bladders) growing near the water's edge, and many mussels. The mussels were all very small, and the wrack of light colour. Here, then, were just the anomalous conditions for sustaining such paradoxical creatures as are found in the coal measures; water certainly fresh enough for many river animals to live in, and yet salt enough to sustain marine animals and plants. The place where I drank the water was about ten miles from Odde, where the fjord terminates, and nearly 100 miles from the open sea. In one direction there is, of course, a gradually increasing salinity: in the other, a gradual diminution, owing to the inflowing rivers.

I should add that the upright trees found in the coal measure strata, and occasionally with their roots actually in the coal seams, which have mainly supported the theory that the vegetation forming the coal seams actually grew on the spot, are easily accounted for by my theory of coal formation, seeing that some of the trees swept down carry a certain quantity of soil or fragments of rock entangled in their roots. These, of course, compel the tree to float vertically in deep water, and if they are not washed away the tree will sink in this position. This also accounts for the anomalous fragments of shaly rock that every burner of coal knows are sometimes imbedded in the best of samples. Their frequent and yet anomalous occurrence in the midst of a deposit where the general mineral matter is so very finely divided, demands explanation, and no theory which does not grasp them can be satisfactory.

I may add that I have lately learned that vegetable avalanches, similar to those above described, occur on a very grand scale in the Straits of Magellan. They are there associated with landslips, and their vestiges in the form of smooth striated rock have, until lately, been attributed to glaciation, but recent observers have corrected this mistake.

It should be noted that if any approach to the exceptionally hot and humid climate, generally supposed to prevail during the carboniferous period, actually did exist, the luxuriance of vegetation on the slopes of the fjords of that period must have been vastly greater than those of Norway, and the rate and quantity of vegetable deposition proportionally magnified.

I have yet to consider the peculiarities of the strata above and below the actual seams of coal; will describe them and discuss their formation in my next.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By Edward Clodd.

VI.—THE PAST LIFE-HISTORY OF THE EARTH (*Concluded*).

THE warm climates of the Secondary epoch prevailed far into the Tertiary, but were followed by declining temperatures, which at last resulted in the long and intermittent period of intense cold known as the Glacial epoch, when large areas of Europe and North America were swathed in ice, which gouged and moulded the subsiding land, choking the sea with *débris*, and destroying numberless species of plants and animals, to the lasting biological impoverishment of after times. In the end the temperature rose to its present level.

The Tertiary epoch marks the beginning of the present order of things, of the distribution of land and sea, and the uprising of most of the great mountain chains. Although much of the existing land area was then submerged under shallow seas, the continents of both hemispheres had wellnigh the same outlines as now. Varied as are the life-forms of that epoch, unrelated and, save in the nummulitic limestones, detached as are the strata, those life-forms manifest a gradual approach to existing species, and a marked divergence from the species of older epochs. The colossal reptiles of Jurassic and Cretaceous times, the coiled ammonites and other mollusca of their seas, are extinct. The Age of huge Reptiles has given place to the Age of huge Mammals, with its intermediate forms, but with no one species dominant, and with no important species unrepresented.

The links between the Secondary and the Tertiary epochs are, with rare exception, only meagrely represented by any known strata, for denudation has wellnigh swept away the intermediate deposits with their contents. And so confused are the Tertiary strata that their order in time is determined solely by the proportion of their shell-fish to existing species, ranging from as low as three per cent. in the oldest beds to ninety-five per cent. in the newest. Mollusca have been called the alphabet of palæontology, because their extensive distribution through the several epochs renders them the most valuable and trustworthy of all organic remains in assigning the order in time, and the conditions of life, not only of their own species, but of other species whose life-history is briefer, and whose range is more limited.

The rocks of the Tertiary epoch witness to wide-spread aqueous and volcanic action. This is specially noticeable in the Eocene strata, prominent among which are the vast beds of limestone laid down when Europe, its north-west corner excepted, and Central Asia were covered by the sea, and which extend from the Pyrenees to China and Japan, and also largely compose the Alps, Carpathians, Himalayas, Atlas, and lesser mountain-chains. Not many noble nor mighty are called to the enduring tasks of nature. It is the minute agents, unresting and wide-spread, that have been the efficient causes of much that is grandest in earth-structure, and it is of shells of the coin-like nummulites that these stupendous formations are mainly composed. Their foundations were laid in Archæan times in the deep, broad fissures opened in the crust by volcanic action. Into these fell the sediment and organic deposits of ancient seas, which ultimately, as the cooling crust caved-in by its own weight upon the shrinking hot nucleus, were squeezed and puckered and overturned by lateral pressure into numberless folds. Then, when the twisted and crumpled strata were upheaved above sea level, water and the powers of the air sculptured them into pinnacle and peak, into ravine and valley. So the big mountains, as we know them, are relatively modern; the lesser ones are the older, as longest subject to the wear and tear of eroding agents. Mont Blanc and the Matterhorn are not older than the Eocene marine clay on which London stands, and the Rigi, a freshwater shingle-bed, is younger still.

Broadly grouping the life of Eocene seas, we find large whales, teleost or bony-skeletoned fish in abundance, and the persistent ganoids. Birds are in the air; crocodiles and turtles swarm in the shallows;* snakes and serpents make their first appearance; the mammals are no longer restricted to pouch-bearers, for the placentals have invaded Europe in large numbers—huge quadrupeds, carnivora, hornless deer, and hog-like forms of a type between the tapir and the horse. Among the most remarkable fossils from North American beds are those of the ancestor of the horse, a creature about the size of a fox, with four hoofed toes on each foot, and in one form (*Eohippus*) with the rudiments of a fifth toe, of the importance of which more anon. A still more significant biological link is found in the lemuroids of the Upper Eocene (which belong to the Primates, or order of mammals including man and ape), possessing characters allying them to one or other of the hoofed quadrupeds then living. The plants, which were slowly dispersed over the Northern hemisphere from Polar regions, were tropical in character, as shown by remains in the Thames delta and corresponding deposits.

The like applies to the flora of early *Miocene* (in which is included *Oligocene*) times, when timber-trees, evergreens, and water-lilies flourished within eight degrees of the North Pole, with which Europe and America were connected by way of Iceland and Greenland, although, such are the puzzling climatal variations of past epochs, icebergs were then floating in Northern Italy. The animals approximate more nearly to those of the present, save in the huge size of the mammals, as the mastodon and other creatures allied to the elephant; monkeys as large as a man appeared; the horse corresponded more nearly to his modern descendant, the variation being that each foot had three toes, of which only one touched the ground. Birds and insects were abundant: of the latter 1,300 species have been found in Switzerland alone.

The *Pliocene* period ushered-in great local changes in land and water distribution. The lofty ridge, clothed with oaks and vines, that had stretched from France to Greenland, and the remnants of whose lofty volcanic chain, of which Hecla is the sole active relic, are extant in the Hebrides and the highlands of Scotland and Wales, was submerged. Europe was thus severed from America, but Britain was left as a peninsula, the newly-invading waters of the North Sea dividing Scotland from Norway. On the other hand, the Eurasian continent was upraised in parts, leaving the deeper basins of the Black, the Aral, and the Caspian

* "More true turtles have left their remains in the London clay at the mouth of the Thames than are known to exist in the whole world."—Sir R. Owen, "Palæontology," p. 281.

Seas as remnants of the shallow waters that had linked together the Baltic and the Persian Gulf, the Arctic and the Indian Oceans.

Except in the gradual extinction of the larger species, the hippopotamus alone surviving to this day, the mammals varied little from those of the Miocene, the most remarkable among the carnivora being the fierce sabre-toothed felines. But fauna and flora alike witness to a cooling climate. The life-destroying agencies are at work; the cold fingers of the ice-giant are being spread over the northern hemisphere to the 50th parallel of latitude, dinting and rounding its surface, and leaving to this day the traces of their impress in the snow-fields and glaciers of Scandinavia and Switzerland.

Upon the glacial deposits, or boulder clays, only the most recent of which contain fossils, and these poor and scanty, rest the strata of the present geological epoch, the *Quaternary*, or *Post-Tertiary*, or *Pleistocene*, as it is variously called. This is subdivided into the Post-Pliocene and the Recent, the former containing the remains of many extinct animals, as huge wingless birds and sloth-like mammals; and the latter the remains of none but existing species. It is to some early, perhaps a milder interglacial, period in the Quaternary epoch in Western Europe that the first appearance of man, the latest and highest animal, is to be referred, the evidence of this being more in his works than in himself, for the scantiest remains of his fragile skeleton have been preserved. The roughly chipped stone tools and weapons with which he made shift have been found buried in ancient river gravels with bones of the mammoth or woolly-haired elephant and other arctic animals, as well as with bones of temperate and tropical animals, witnessing to sharp alternations of climate. Stone implements and rude works of art of a somewhat more advanced race, possibly allied to the Eskimo, have also been found associated with remains of sub-arctic animals in limestone caverns. How long before this man appeared on the earth, or whence came the Drift-men and the Cave-men, we cannot say. So far as our present imperfect knowledge of "primitive" man goes, the Palæolithic or Old Stone Age marks the limits of his place in the life-record. A wide gap of different conditions separates the rude savages of that age from the progressive races of the succeeding periods into which pre-historic time is divided—namely, the Neolithic or Newer Stone Age, the Age of Bronze, and, lastly, the Age of Iron, which merges into the brief and modern period embraced by the historian.

In the foregoing rapid summary of the earth's past zoology and botany much of detail has been left out for clearer presentment of the typical features of each epoch and of the scale of life as an ascending scale. The older the rock the simpler the life-forms.

The lichen and the seaweed, stemless and leafless, are lower than the club-moss and the tree-fern; these are lower than the true timber-tree with its complex arrangement of trunk, branches, leaves, flowers, and fruit. The shapeless amœba is lowest in the scale; the sponge, rooted plant-like to the rock, is lower than the coral or the starfish; these, again, than crabs or shell-fish, the most highly organised of which are lower than the vertebrates, between the several groups of which the ascents are manifest in fish, reptile, bird, and mammal. And among these last there are the lesser and the greater; the pouch-bearers, bringing forth their young immature, are less specialized than the placentals, bringing forth their young fully developed; while here, also, the ascending grades are seen in whales, ungulates, carnivora, monkeys, men.

To all which the fossil-yielding rocks bring their witness. Imperfect as is their record, obscure as in certain cases are the causes of modification resulting in the appearance of new types, the evidence as to ascent of life from the simple to the complex, and as to its succession, is overwhelming. There was a time when the earth was devoid of life, and we are doubtless very far from its "protoplast" beginnings in the earliest known organic remains, just as all species probably came into being long before we have any trace of them. But no evidence as to their real first appearance that may be gathered from parts still unexplored is likely to alter the relative order assigned to the several types as compared with one another.

TABLE OF THE SUCCESSIVE APPEARANCE OF TYPICAL LIFE-FORMS.

Epoch.	System.	Animal.	Plant.
EOZOIC (Earliest Life-forms)	Laurentian	*Eozoon Canadense* (?)	Sea-weeds, club-mosses
	Cambrian	Sponges; corals; crustacea; shell-fish	
	Silurian	Huge crustacea; the lowest known vertebrates (ganoids or armoured *fish*)	
PRIMARY or PALÆOZOIC (Age of Ferns and Fishes)	Devonian	Insects; swarms of ganoids	Ferns, calamites, cycads
	Carboniferous	Land vertebrates (Labyrinthodonts)	
	Permian	*Reptiles*	
SECONDARY or MESOZOIC (Age of Pines and Reptiles)	Triassic	Immense reptiles; *marsupial mammals*	Conifers, palms
	Jurassic	Immense bird-reptiles; true *birds*[*]	
	Cretaceous	Bony-skeletoned fish; large ammonites	
TERTIARY or CAINOZOIC (Age of Leaf-forests and Mammals)	Eocene	Huge *placental mammals*; serpents; nummolites	Trees, shrubs, herbs allied to existing sub-tropical species
	Miocene and Pliocene	True whales; Man-like Apes	
	(Glacial ing into the)	Epoch intervening, and continu-	
QUATERNARY	Post-Pliocene	Mammoth and other woolly quadrupeds; Man	Arctic and temperate
	Recent or Historic	Existing species	Existing species

[*] The discovery of the lowest mammalian forms in earlier strata than those containing birds seems opposed to the accepted order of succession, but there is considerable uncertainty as to the exact period of the first appearance of birds.

The history of the earth is written by fire and water; its life-history by water alone.

The volcanic and other modes of igneous disturbance that have upheaved, depressed, contorted, and fissured its cooling crust are due to the internal energy manifest in the escape of pent-up heat and in chemical action. The more potent agents of change in the visible crust, however, have not been from within, but from without. As the internal energy, derived from contraction of the hot nucleus, decreased, the energy derived from the sun became more effective, giving rise to changes wherein variations of temperature and the circulation of air and water over the surface of the earth would come into play. It is to these—to the solvents of the atmosphere and rain, to the driving wind, to water in its several states and movements, whether of disrupting frost, grinding glacier, eroding river, or waves and currents of the sea—that the five-and-twenty miles and more of stratified rocks (for the same stuff has been used over and over again), with all the varied contour of the earth's surface, are mainly due.

Vast, slow, and continuous as are the changes, they occur within defined limits. The deep ocean basins, the lines or seams of the great mountain chains, have probably been permanent from the remotest geological epochs, and the variations in land and water distribution have been confined to certain areas. All the evidence furnished by the aqueous rocks, from the earliest primary to the alluvial formations of to-day, point to their tranquil deposition on the floors of relatively shallow seas, where they have been converted by pressure and other means into solid beds, entombing organic

remains which give the key to their relative place. Then, on their upheaval above the sea, the eroding agents have begun their slowly levelling work, and the *débris* of lands, where life-forms have flourished and perished, has returned to the waters whence they uprose, to become once more "the dust of continents to be." And so "the thing that hath been, it is that which shall be; and that which is done is that which shall be done: and there is no new thing under the sun." Between the opposing agents of waste and repair, of upheaval and subsidence, with interplay of the organic in growth and decay, as in limestone ranges, coral isles and coal beds, and the action of man himself for evil or good on nature, the ancient earth is maintained from age to age mother of all living.

MIND ACTING ON BODY.

By Richard A. Proctor.

THERE are few circumstances in mental physiology more surprising when rightly understood, few perhaps more suggestive, than this, that ideas conceived in the mind—that is, as we are in the habit of supposing, the results of processes taking place in the grey matter of the brain—should influence not only voluntary but involuntary bodily processes, nay, not only respiration, circulation, and so forth, but the various processes of secretion on which the nutrition of different parts of the body depends. There is no novelty, of course, in the recognition of this circumstance, though I venture to express the belief that quite a large proportion of those who may read these pages will find considerable novelty in some of the evidence I shall adduce. But the fact that the relations here considered have long been recognised by physicians and students of mental physiology does not detract from the interest of the problem presented by these relations. It may truly be said that as yet they have not been in the least degree explained. Yet the problem is not one which appears at a first view so hopelessly beyond all our attempts at solution as some which are connected with mental and corporeal matters. We can understand, for instance, that the student of mental physiology should at present turn hopelessly from the attempt to explain how thought should in any way depend on changes in the substance of the brain, or again, from the task of attempting to determine how, by any process of evolution, the phenomena of consciousness should have been developed from cerebral changes which in their simpler form appear to result in automatic movements. But we have no such seemingly hopeless problem in the subject now to be considered. For in reality it amounts simply to the question how or why certain changes in one part of the body lead to changes in other parts of the body. The distinctions between mind and matter, between thought and cerebral activity, are not here involved. A problem apparently physical, and physical only, is submitted to our investigation. Yet hitherto the solution of this problem has not been attained; nor, indeed, does there seem at present to be good reason for regarding it as attainable.

Let us turn, however, to the consideration of certain remarkable illustrations of the influence of the mind on bodily functions. The subject is specially suited for the use of the inductive method. Indeed, the chief difficulty we are likely to find in the application of this method resides in the probability that our space will be too limited to afford room even for a single instance of each class of illustrative cases.

By a coincidence it so chances that the great modern advocate of the inductive method of research—Francis Bacon—supplies a very effective piece of evidence as to the influence of the imagination on external growths which seem to have their origin in deficient vitality of certain parts of the external surface of the body—as warts, wens, and the like. Bacon did not, however, treat the evidence afforded in his own case with the acumen which might have been expected from the inductive philosopher. "I had from my childhood," he says, "a wart upon one of my fingers; afterwards, when I was about sixteen years old, being then at Paris, there grew upon both my hands a number of warts, at the least an hundred in a month's space. The English ambassador's lady, who was a woman far from superstition" (a statement which must be taken *cum grano*), "told me one day she would help me away with my warts; whereupon she got a piece of lard with the skin on, and rubbed the warts all over with the fat side; and amongst the rest that wart which I had from my childhood; then she nailed the piece of lard, with the fat towards the sun, upon a post of her chamber window, which was to the south. The success was that within five weeks' space all the warts were quite away, and that wart which I had so long endured for company. But at the rest I did little marvel, because they came in a short time, and might go away in a short time again; but the going away of that which had stayed so long doth yet stick with me."

Bacon considered the result of the experiment to have been due to some sympathy which he supposed to exist between the lard and the warts after they had once been in contact. It is difficult for us to understand how so absurd an explanation could even for a moment have been entertained by Bacon—not when, as a mere boy, the experiment was successfully tried upon him, but in after years, when he had learned to study the relations of cause and effect. The servant who places a poker across the top bar of the grate, under the impression that in some occult way the fire will be made to burn more actively through this arrangement, adducing this or that case in which a fire so treated did burn up as sufficient proof that the method is infallible, does not seem to reason (if one can call such a mental process reasoning) more absurdly than Bacon did when the experiment which "so stuck with him" satisfied him that the drying of grease which had once touched his warts could cause the warts themselves to disappear, though the skin was hung up in one place while he and his warts were in other places, and no contact remained between the warts and the skin of lard. If the idea of some occult sympathy between the fat and the warts could really arise in a mind "far from superstition," one would suppose it must have occurred to Bacon that the justice of this idea could be very readily put to the test. He had only to apply a skin of lard to some one's warts, and then submit the skin to a variety of more active processes than mere sun-drying, inquiring whether the warty person found sudden relief, sudden pain, or any effect whatever, when the nature of such experiments was kept concealed from the said patient. One can understand that those who were not far from superstition might imagine the experiment to be really rendered effective by charms, prayers, and incantations, or by some mystical ceremonies or other which were not disclosed to the patient. We know that in Bacon's time, and to a far later date, the efficiency of such magic devices was believed in by many who called themselves philosophers. To this day there are many who are foolish enough to indulge in such beliefs. But Bacon regarded the process of cure as purely natural, though, as one would suppose, the evidence against such a view should have appeared insurmountable to a man of his reasoning power. We must, however, remember that in his day it must have appeared almost, if not quite, as unreasonable to assume that the

imagination could affect a part of the body, as that some secret sympathy might exist between a part of the body and some substance which had touched it. Many readers will remember that Sir Kenelm Digby, in a work published as late as 1658, discusses gravely the influence produced on a badly wounded hand by bathing a garter, which had been stained with the blood, in a basin of water wherein a certain powder had been dissolved. "As soon as the bloody garter was put within the bason," the wounded man "started suddenly as if he had found some strange alteration in himself." "I asked him what he ailed?" proceeds the narrator. "'I know not what ailes me, but I find that I feele no more pain. Methinks that a pleasing kind of freshnesse, as it were a wet cold napkin, did spread over my hand, which had taken away the inflammation that tormented me before.' I replied, 'Since then that you feel already so good effect of my medicaments, I advise you to cast away all your plaisters; only keep the wound clean, and in a moderate temper betwixt heat and cold.' This was presently reported to the Duke of Buckingham, and a little after to the King, who were both very curious to know the circumstance of the businesse, which was" (the story is not so distinct here as could be wished) "that after dinner I took the garter out of the water, and put it to dry before a good fire. It was scarce dry, but Mr. Howell's servant came running, that his master felt as much burning as ever he had done, if not more, for the heat was such as if his hand were 'twixt coles of fire. I answered, although that had happened at present, yet he should find ease in a short time; for I knew the reason of this new accident, and would provide accordingly; for his master should be free from that inflammation, it may be, before he could possibly return to him; but in case he found no ease, I wished him to come presently back again; if not, he might forbear coming. Thereupon he went; and at the instant I did put again the garter into the water: thereupon he found his master without any pain at all. To be brief, there was no sense of pain afterwards; but within five or six days the wounds were cicatrised, and entirely healed." Sir Walter Scott, in speaking of such stories as these, expresses the opinion that possibly the cure may have resulted from the care with which the wound was in the first place washed. It will be observed, however, that Sir Kenelm Digby's account does not countenance this explanation. Nor, if one could accept it as it stands, could one adopt the idea that the imagination of the patient produced the changes of feeling described. For it is clearly stated that the patient felt relief before he knew that the garter had been placed in the basin of water; that the pain returned when the "chirurgeon" in another house had dried the garter, and that the pain disappeared before the return of the messenger who carried back the promise of relief. If such stories as these were current in Bacon's time, and were generally believed, his explanation of the disappearance of his warts, confirmed as it seemed by what he knew of the actual circumstances, may have seemed to him as philosophical as to us it appears absurd.

So the faith, which prevailed for many years after Bacon's time, in the efficacy of the Royal Touch must be regarded as based to some degree on evidence, though the evidence was misunderstood. In days when many believed that a certain divinity doth hedge a king, it was natural that in the first place the imaginations of those folks of feeble vitality, and often of deficient mental power, who were brought to kings to be touched, should be so far affected as to cause such bodily changes as we now know to be produced by a strongly excited imagination; and that in the second place the persons thus cured, and those who heard of such cures, should attribute the effect to the virtue of the kingly touch, not to the influence of mere mental processes. Dr. Todd, in his "Influence of the Mind on the Body," quotes a singular passage from a book by Browne of Norwich, surgeon to King Charles II.—a book rejoicing in the title "Adenochoiradelogia; or, a Treatise of Glandules, and the Royal Gift of Healing them." "A Nonconformist child, in Norfolk," says Browne in the passage referred to, "being troubled with scrofulous swellings, the late deceased Sir Thomas Browne, of Norwich, being consulted about the same, his Majesty being then at Breda or Bruges, he advised the parents of the child to have it carried over to the king (his own method being used ineffectually); the father seemed very strange at his advice, and utterly denied it, saying the touch of the king was of no greater efficacy than any other man's. The mother of the child, adhering to the doctor's advice, studied all imaginable means to have it over, and at last prevailed with the husband to let it change the air for three weeks or a month; this being granted, the friends of the child that went with it, unknown to the father, carried it to Breda, where the king touched it, and she returned home perfectly healed." The worthy doctor is careful that the moral of the story should not be overlooked. "The child being come to its father's house, and he finding so great an alteration, inquires how his daughter arrived at this health. The friends thereof assured him, that if he would not be angry with them they would relate the whole truth; they having his promise for the same, assured him they had the child to be touched at Breda, whereby they apparently let him see the great benefit his child received thereby. Hereupon the father became so amazed that he threw off his Nonconformity, and expressed his thanks in this manner:—'Farewell to all dissenters, and to all nonconformists! If God can put so much virtue into the king's hand as to heal my child, I'll serve that God and that king so long as I live, with all thankfulness.'" It was found later that Hanoverian kings had the same power as the Stuart, even as old Aubrey had noted of the Yorkist and Lancastrian kings. "The curing of the King's Evil," he said, "by the touch of the king, does much puzzle our philosophers, for whether our kings were of the house of York or Lancaster, it did the cure for the most part." And so no doubt it would if the patient had been touched by one of the Gentlemen of the Bedchamber, or by the valet of such a one, or in fine by Tom Noakes or John Styles, so only that the patient was fully persuaded he had been touched by the rightful monarch.

Another "royal personage" succeeded (by a coincidence singular enough, at the same place, Breda) in curing a number of men of a much more active disorder, though in this case the imagination was aided chiefly by the ideas suggested by medicine-bottles of orthodox shape, not solely by faith in royal blood. During the siege of Breda in 1625 many soldiers of the Prince of Orange's army were prostrate with scurvy. The mortality was serious, the patients having altogether lost heart. "This," says Dr. Frederic Van der Mye, who was present, "was the most terrible circumstance of all, and gave rise to a variety of misery; hence proceeded fluxes, dropsies, and every species of distress (*omne chaos morborum*), attended with a great mortality." At length the Prince of Orange sent word to the sufferers that they should soon be relieved, and provided with medicines pronounced by doctors to be wonderfully efficacious in the cure of scurvy. "Three small phials of medicine were given to each physician, not enough for the recovery of two patients. It was publicly given out that three or four drops were sufficient to impart a healing virtue to a gallon of liquor." "We now," says Van der Mye, "displayed our wonder-working balsams, nor were even the commanders let into the secret of the cheat put upon the soldiers. They flocked in crowds about us, every one soliciting that part might be reserved for their use. Cheerfulness again appears in every

countenance, and a universal faith prevails in the sovereign virtue of the remedy. . . . The effect of the delusion was really astonishing: for many quickly and perfectly recovered. Such as had not moved their limbs for a month before were seen walking the streets sound, upright, and in perfect health. They boasted of their cure by the Prince's remedy. . . . Many who declared that they had been rendered worse by all former remedies, recovered in a few days, to their inexpressible joy, and the no less general surprise, by taking (almost by their having brought to them) what we affirmed to be *their gracious Prince's cure*." We may add that on another occasion widespread scurvy was suddenly cured in a very different way: it is stated on good authority, says Dr. Todd, "that in 1744 the prospect of a naval engagement between the British and allied fleet had the effect of checking the scurvy."

(*To be continued.*)

ORIGIN OF THE TEUTONIC LANGUAGES.*

THIS work is a valuable introduction to Teutonic philology, and will be found full of interest by many who regard the study of language from without—in the same sense that the geologist regards the study of chemistry or the palæontologist the study of botany. It is in this last respect that we propose here to deal with the book, and we select, as an illustration of its value and interest, the treatment of the Indo-European languages in the third chapter. We believe that a better idea of the qualities of a book may be obtained by thus examining at full length a selected portion than by attempting to present a summary of the whole in a necessarily imperfect manner.

The languages of the Indo-European family, belonging to the Indo-European races, may be grouped under nine principal heads.

First, we have the Indian group, in which we find the oldest extant form assumed by the original language as it broke up into dialects. The Vêdas are in a language which, though written, represents evidently what was the language spoken by the people when the Vedas were composed. It is, indeed, known that the Vedic hymns existed long before they were consigned to writing. We have in Sanskrit (*i.e.* the language "put together" or "perfect") a language which was developed from the older spoken language, and differing doubtless in some respects from its original; but, though simplified and reduced to a fixed form, it was true in sound and grammar to the older language, just as the English of our books is true to the English spoken by the people. Sanskrit is still employed by the learned in India, just as Latin was employed in Italy long after it had become a dead language in its own home. The ancient popular language in India was called Prâkrit ("vulgar" or "copied"). The modern popular dialects in India are the Hindustani, the Marathi, the Bengali, &c. (The older races did not call themselves Indians, but Aryans.)

Secondly, we have the Iranian group, more properly called Eranian—now the Persian—also calling themselves Aryan, from "Aryas," true or noble, whence Eran is directly derived. We have very ancient works of old Persian in cuneiform inscriptions relating to Darius, Xerxes, and Artaxerxes. These inscriptions are numerous enough to give a good idea of the language. Of the old Bactrian, or East Eranian language, called Zend, we have specimens in the Avesta, or sacred writings of the Parsees. The language shows signs of great antiquity. In the commentaries on the Zend Avesta we have samples of the Middle-Eranian languages, which present many Semitic and Arabic words. The finest example of modern Persian is the Shahnameh or Book of Kings, dating from 1051 A.D. Modern Persian has a simple grammar—simpler even than English; it does not even mark gender in the third personal pronoun.

Thirdly, we have the Armenian group, connecting the Asiatic and European. The Armenian language has many features in common with the European languages of the same family. It is interesting as giving us the only evidence we have about the languages spoken by the Phrygians, Lydians, Carians, and other extinct peoples of Asia Minor.

Fourthly, we have the Greek group. The languages of this group differ little from each other, being rather dialects than distinct languages. (Professor Meyer, of Graz, has, however, suggested that Albanian is an offshoot of the Greek family, and, if this is so, we certainly have in it a language which shows more than a dialectical difference from the Greek.) We find in Greek the signs of greater antiquity in some respects even than in Sanskrit. This is to be recognised in the Doric and Æolian dialects more clearly than in the Ionian and Attic. The differences between the imperfect and the aorist, between perfect and pluperfect, and between optative and conjunctive, are especially characteristic of antiquity, as are also the dual forms in declension and conjugation. Modern Greek is a true development from ancient Greek, not a distinct language.

Fifthly, comes the Italian group. The original language is not known. But in Old Latin, Umbrian, and Oscan, we have its immediate offspring. (Etruscan is doubtful, and Messapian does not belong to the Italian group.) Latin, as we find it in literature, was not spoken at any time which can be defined. The spoken language changed constantly, but written Latin remained without change. It was only when the changes of dialect had left written Latin an entirely distinct language that the new dialects came to be themselves employed in writing; so that the various Romance languages were spoken long before we have any written record of their existence. Of these Romance languages the modern representatives are the Italian, Roumanian, and Romaunsh (spoken in the Engadine) in the east; the Spanish and Portuguese in the south-west; the Provençal (*langue d'oc*) and the French (*langue d'oil*) in the north-west. (Modern written French was formed from the dialect of the Ile-de-France, the old Duchy of Francia.)

Sixthly, the Celtic group. The oldest records of the original language of any value (for Greek and Roman records are practically valueless) are found in glosses and interlinear versions of Irish ecclesiastical writers, and date from near the end of the eighth century. But even at that stage the Celtic showed signs of decay. The Old Irish is the best of all the Celtic languages, and appears to stand nearest to the original. Modern Celtic is divided into two groups—the Irish division, which includes modern Irish, Gaelic, and Manx; and the Cymric, including Welsh, Cornish, and Bas Breton, or Armorican. (Of these the Cornish is now a dead language.)

Seventhly, we have the Slavonic group. Here also the original language is lost; but the Old Bulgarian, which we have in MSS. dating from the eleventh century, is near the original language in most of its forms. On the contrary, the modern Bulgarian is the most lawless of all Slavonic languages. Servian is one of the oldest of Slavonic dialects: it can be traced back to the ninth century. Croatian is a dialect of Servian. We have a record of the Slovenian dialect (now spoken by the Slavonic inhabitants of Carinthia,

* "Outlines of a History of the German Language." By H. A. Strong and Kuno Meyer. Sonnenschein & Co., London.

Styria, and Carniola) dating back as far as the tenth century. Russian and Little Russian (a distinct dialect) can be verified as far back as the eleventh century. Those are the Eastern Slavonic dialects. The Western are the Polish, Czech or Older Bohemian, Modern Bohemian, and Sorabian or Wendish.

Eighthly, the Lithuanian group. The oldest records of the Lithuanian language date no further back than the middle of the sixteenth century. Old Prussian, which was nearly related to Lithuanian, is now dead, having been replaced in the latter half of the seventeenth century by German. Lithuanian is dying out south of the Niemen, where it is called High Lithuanian; but Low Lithuanian, north of the Niemen, remains. Lettic, spoken in Courland and Livonia, is a younger form of Lithuanian.

Lastly, we have the group to which our own language belongs—the Teutonic languages. The original form of the Teutonic language cannot now be ascertained, Gothic being the nearest representative of that language of which records remain.

"Of all the Teutonic languages," remark our authors, "the Gothic, speaking generally, presents the most ancient characteristics, and in fact approaches most closely to the original Teutonic language. The Gothic language enables us to draw the most trustworthy conclusions as to this original language. Of all Teutonic languages it alone still retains the medio-passive forms common to the Greeks, the Indians, and the Eranians, forms which the Letts and the Slavs have completely lost. Again, it alone has preserved in its entirety the perfect reduplication, and it alone still maintains in their least crippled form the grammatical terminations of the old language. But true as Gothic has in the main been to the primitive type, it has still lost many forms which other German stocks, notably the Old High German and Old Norse, still possess—a sufficient proof, among others which might be cited, that neither German nor Norse can possibly be descended from Gothic; both of these languages have retained single heirlooms, inherited from the common mother, in a greater state of perfection than the Gothic heiress-in-chief." Almost our sole knowledge of Gothic is derived from the translation of the Bible by the Gothic Bishop Vulfila, better known by the Greek form of his name Ulfilas. He lived from 311 to 381 A.D. A few scanty fragments of Gothic exist outside that work. The Gothic language died and left no issue, so that it is in a truer sense dead than Latin and Greek. As is well known, the Goths employed the Runic alphabet, which was derived from the Roman.

Old Norse is known not only by the written literature which has existed since the twelfth century, but by ancient Runic inscriptions. A peculiarity of the Norse shows itself in the earliest inscriptions—the change namely of final *s* (voiced, or *z*) into *r*. Thus, in the "Golden Horn," we find for *gastiz*, Gothic *gasts*, a "guest," the form *gastir*. In 1397 Danish became the language of the better sort in Norway, and Norse split up into many dialects.

Old Saxon exists in the "Hêljand," an alliterative poem about Christ, and in some unimportant records. The Frisian, Franconian, and High German are the nearest neighbours to the Old Saxon. Middle Low German is found in many writings, but has no literature. New Low German, or Plattdeutsch, possesses a literature of modern date only. Of Low Franconian, spoken on the Lower Rhine, the oldest record is found in the Franconian glosses on the Salic code, written in Latin in the Malberg (Mahal-berg, or "Mount of Justice"). Then we have High Dutch, Middle Dutch, New Dutch (including Dutch Proper, Brabantian, and Vlamisch), the Frisian, the Anglo-Saxon (Old and New), and lastly English.

Our authors treat specially, of course, of the High German language, respecting whose history they give many curious particulars. (The chapter on popular and forgotten etymologies is singularly interesting.) Every one who cares for the philology of languages as compared with mere grammar and vocabularies will enjoy this work immensely.

AMERICANISMS.

(*Alphabetically arranged.*)

By Richard A. Proctor.

Caboodle. See "Boodle."

Caboose. The last car of an American luggage-train. Sometimes used for *Calaboose.*

Cache. A hole in the ground for hiding provisions. (French.)

Cachunk, or *Kerchunk.* With a noise or thump.

Calaboose. The common gaol.

Calculate. Used like "guess," especially in New England. I have occasionally heard "cal'late," as in the "Biglow Papers."

Camp-meeting. See *Big meeting.* An American way of advertising religious character.

Candidacy. Bad English for "candidature."

Cañon. (Sp.; pron. Canyon.) A narrow passage cut by rivers between precipices.

Canuck. A Canadian.

Canvas Back. A wild duck, found chiefly in Chesapeake Bay, of excellent flavour, but somewhat overpraised in America.

Car. A railroad carriage.

Carpet Baggers. Unprincipled adventurers, who went south after the war between the North and South to feed on the substance of a prostrate people. General Wade Hampton correctly employed the synonym "thief."

Carry Guts to a Bear. An expression much used in America to express worthlessness. But it is of early English origin. "He said you wern't fit to *carry guts to a bear*," said an English servant (long before the Irishman) to his master. "Well, and what did you say?" angrily asked his master. "I said you *were*," indignantly replied the man.

Catawamptious. Fiercely eager. A ludicrous monstrosity, says Mr. Bartlett, of the South-Western States. Probably a gift from the coloured folk.

Catch on to. Verb. To catch on to a plot or plan is to seize the idea of it.

Catfish. A favourite fish in America, offensively called a Siluroid by European naturalists. It is called also the Horned Pout, Bullhead, Minister (!), and sometimes simply the Cat. It is not beautiful.

Caucus. A private meeting of the leaders of a party, usually for some rascality, so that the term has an unpleasant sound in American ears.

Caution. Noun. A very striking warning. A "caution to sinners" means something appalling. We also often hear of a "caution to snakes," which sounds idiotic.

Cave. To "cave in" is to give way.

Cavort. Verb. To prance. Corruption from "curvet." Most American expressions of the sort are corruptions.

Chaw. To "chaw up" is to demolish. Probably derived from the American system of rough-and-tumble fighting, which includes biting or chawing as a legitimate way of discomfiting an adversary.

Checkers. The game of draughts.

Checks. Counters used to represent money or other kind of property. As in gambling a man passes in his checks at

the close of the play, a man is poetically said to "pass in his checks" when he dies.

Chemiloon. A "combination" of chemise and pantaloon: a feminine dress. Dr. Mary Walker, lecturing on dress, said, "I wear suspenders, and I feel awfully good in my chemiloon." See *Bad.*

Chicken-fixings. Originally a chicken fricassee, now applied sometimes to any particularly fine arrangements, as distinguished from "common doings."

Child, This. Meaning "myself." Nigger American (very popular).

Chip in. Verb. To take part in proceedings originally started by other folks. "They was taking Sam Willing to pieces like—Sheol—so I chipped in, and I says——" but what he said is too profane to be quoted.

Chipmunk. The striped squirrel.

Chivaree (Fr. *Charivari*). When an elderly man marries a young girl, it is a pleasing custom in Louisiana, Missouri, and other States of the West and South-West, to serenade the newly-married couple with bells, kettles, horns, and whatever will make the most discordant uproar. The respect shown by Americans to the fair sex is remarkable.

Chop. First Chop means first class. The expression is borrowed from the Chinese.

Chowder. A dish of fish, pork, onions, and biscuit.

Chunk. A short thick object; originally a piece of wood. The term is used in its original sense in England. But in America they talk of a chunk of a man, or even a chunk of poetry.

Chunky. Short and thickset. A chunky man is a short, fat person.

Cimlin. A squash.

Cincinnati Oysters. Pigs' feet.

Circumstance. A trifle. "K is a big man, but he's not a circumstance to Mrs. B.: it takes two men and a boy to see her all at once."

City. A small village.

Claim. A place marked out as some one's property.

Claim. Verb. To assert. "J. claimed to be unable to pay."

Clam. Certain shell-fish are called clams, as the hard clam (*Venus mercenaria*), the soft clam (*Mya arenaria*).

Clam Bake. Clams baked in the earth.

Clam Chowder. See *Chowder*, and include clams in the dish.

Clean Thing, The. What is right. "A low expression," Bartlett says: I venture to differ from him.

Clear Grit. Honest courage.

Clearing. A piece of land cleared for cultivation.

Clear Out. Verb. To get away. Sometimes used without the preposition, "Gentlemen, will you please clear, is American for "Get out!"

Clever. In American this word usually means well disposed and good-natured. An English lady, told in America that a girl was "clever but not smart," thought she had found just the kind of help she wanted, handy but not dressy; she found the girl kindly but stupid.

Cleverly. Neatly and well, as in English; but also pleasantly.

Coasting. Sliding down a snow-covered hill: a method of breaking limbs very popular in America.

Cobbler. A drink made with wine, sugar, lemon, and pounded rice, imbibed through a straw.

Cocktail. A stimulating drink made of spirits, bitters, sugar, and a suspicion (very vague) of water.

C. O. D. Collect on delivery. Often used as a colloquial expression.

Codding. Playing the fool.

Colonel. A title applied in America, especially in the south and west, to any one who has taken any part in military or military matters; also to many who have not.

Collect. Verb. "To collect" is used short for to "collect payments."

Collide. To come into collision. Used by Dryden and Burton.

Come. To "come it over anyone," is to get the better of him. To "come it strong" is to act or speak vigorously. The expression is often used in England.

Common Doings. Ordinary commonplace fare. See "Chicken-fixings."

Conceit. Verb. To think; to take a fancy or conceit.

Conductor. The conductor of an American train corresponds to our guard, but has a more responsible position, and considerably more self-respect.

Confidence. The Confidence Trick. Bartlett innocently confides in the story that the confidence trick was first played a few years ago in New York. It is hardly necessary to say that it is at least a century old in England.

Connection. "In this connection." A New England phrase for "in connection with this subject."

Conniption Fit. A feminine expression, apparently equivalent to a "fit of hysterics."

Considerable is often used in America as equivalent to "a good deal." Thus "he is considerable of a judge" means he is quite a judge. Also "considerable" is used as an adverb, "considerable smart" for tolerably smart, and so on. English is spoken with considerable of a change in the United States, but is supposed (there) to be considerable correct.

Continental. This word was frequently used for "colonial" in the time of the War of Independence.

Contrabands. At that time negro slaves were called "contrabands," because treated as contraband of war. The same word was used (and mistakenly supposed to have been invented) during the war between the North and South.

Contraption. A contrivance.

Cookery. A little cake.

Coon. A raccoon. Also a member of the old Whig party. A chap. A "gone coon" is a man whose case is hopeless.

Coon's Age. A coon's age means a long time. Vague.

Coot. A small waterfowl. A silly person. Also equivalent to our Cockney word "cove."

Copperhead. A kind of snake. The term was pleasantly applied in the North to Northern sympathisers with the South. Irving applies it to the Dutch colonists.

Corduroy Road. A road made by laying logs side by side over swamps.

Corn in America always means Indian corn or maize. What we call corn in England they call grain in America.

Corn Cob. The spike on which the kernels of corn grow.

Corn Cracker. A Kentuckian.

Corn Juice. Whisky.

Corner. A corner is the purchase of a larger amount of any kind of stock than is really in the market.

Corner Lot. A house or building at a corner of a block.

Corral. A pen for securing cattle.

Cotbetty. Equivalent to the old English cotquean—a man who meddles in women's business.

Count. To reckon (used like "guess" and "calculate").

Cowboy. A cattle-herder in Texas and the Far West generally. Used also generally for low ruffians or rowdies.

Cow-catcher. A contrivance for clearing animals out of a train's way.

Coyote. The prairie wolf.

Cracker. What we call "biscuits" they call "crackers" in America. See *Biscuits.*

Cradle. A machine, like a cradle in shape, used in washing out gold-dust. Also called a rocker.

Crank. Adj. Fanciful (also *Cranky*). Noun. A fanciful person.

Crazy. Used where we say "mad." Crazy seems never used in America to mean shaky.

Creole. Strictly, one born in America of European parents. In Louisiana and elsewhere down South they apply the term to any native productions, so that we hear of *creole* cattle, *creole* cabbages, and so forth. In New Orleans the term *creole* is limited to persons of pure French extraction, so that Mr. Cable's mistake in applying the term to mulattos and quadroons has given great offence there.

Crescent City. New Orleans.

Crevasse. An opening in the levees on the Lower Mississippi.

Crowd. Used for "company," this word is purely American. "He called for liquor for the crowd," meaning for the whole company. Also used as a verb where we should say *squeeze; e.g.* to *crowd* a person's hand affectionately.

Crower. Like "rooster," for *Cock.*

Cruel. Used adverbially for "very."

Cunning. A feminine word for anything small and pretty, or taking. A lady comforted me when the news reached me in America that twins had been born to me in England, by saying that twins are always so "cunning."

Curious. Yankee for particularly fine. As curious cider, for singularly good cider.

Cuss. This word is used sometimes for "curse," and sometimes for "customer."

Cussedness. Perversity.

Cuss-words. Oaths.

Cutting Didoes. Playing the fool; cutting capers.

Cute. Keen. Also used like "cunning," for quaintly pretty, or simply quaint.

Cutting it fat. Overdoing anything, especially applied to flattery. Cockney, also.

Cut up. To be riotous. "Oh, heart! stop cutting up," a curiously poetical way of saying, Cease beating so violently. "Cutting up shines" is equivalent to "cutting capers" in English.

Dander. This word is really short for Dandruff. To get one's dander raised, or riz, is to be put in a passion. The hair is supposed to stand on end with rage, as with fear; and the hair rising might be supposed to raise the scarf at the hair's roots. So there is poetry here also.

Danites. Men whom the Mormons are said to employ to kill the enemies of the Mormon faith.

Dark and Bloody Ground, The. A name applied to Kentucky, the battle-ground between Northern and Southern Indians and afterwards between the Indians and the first white settlers.

Darky. A negro.

Dark o' the Moon, or *Dark Moon.* Short for "Darkening of the Moon," the time from full moon to new moon.

Darsn't, for *Dares not.* As commonly used in America, Darsn't appears to be conjugated thus—I darsn't, (thou darsn't), he darsn't, we darsn't, you darsn't, they darsn't.

Dead-Beat. A mixture of ginger, soda, and whisky taken at the close of a long carousal. Also, see *Beat.*

Dead-heads. Persons who travel, drink, or go to places of entertainment without paying.

Death. To be death on anything is to be a sure hand, as we say in England. The expression, no doubt, had its origin among hunters.

Deck. A pack of cards. Used by Shakespeare, 3rd part of "Henry VI.," v. 1.

Decoration. A day, generally towards the end of May, appointed for decorating tombs of soldiers and sailors who fell in the war between the North and South, or of politicians who were active during that war.

Deed. Verb. To transfer by *Deed.*

Deestrick. An American way of pronouncing the word "district." It is not *the* American way, of course.

Depot. Fr. Pronounced *dee'po.* A railway station; always so understood unless accompanied by a word defining the depot differently, as *provision deepo*, &c.

Dessert. Fr. This word, which really means fruit or whatever is eaten after the dinner itself has been cleared away (*desservi*), is often applied in America to pastry. It is sometimes pronounced de'sert. Better perhaps to be wrong all round than half wrong half right.

Dicker. Verb, to barter. Noun, barter.

DEATH CUSTOMS OF THE INDIANS.

By "Stella Occidens."

WE have observed the care with which the Otoe and Missouri Indians preserve the body from being touched by the earth: the Comanches of Indian territory go to the opposite extreme. "When a Comanche is dying, while the death-rattle may yet be faintly heard in the throat, and the natural warmth has not yet departed from the body, the knees are strongly bent upon the chest, and the legs flexed upon the thighs. The arms are also flexed upon each side of the chest, and the head bent forward upon the knees. A lariat, or rope, is now used to firmly bind the limbs and body in this position. A blanket is then wrapped around the body, and this again tightly corded, so that the appearance when ready for burial is that of an almost round and compact body, very unlike the confused pall of his Wichita or Caddo brother. The body is then taken and placed in a saddle upon a pony, in a sitting posture, a squaw usually riding behind (though sometimes one, on either side of the horse) holds the body in position until the place of burial is reached, when the corpse is literally tumbled into the excavation selected for the purpose. The deceased is only accompanied by two or three squaws, or enough to perform the little labour bestowed upon the burial. The body is taken due west of the lodge or village of the bereaved, and usually one of the deep washes or heads of cañons, in which the Comanche country abounds, is selected, and the body thrown in, without special reference to position. With this are deposited the bows and arrows; these, however, are first broken. The saddle is also placed in the grave, together with many of the personal valuables of the departed. The body is then covered over with sticks and earth, and sometimes stones are placed over the whole. The best pony owned by the deceased is brought to the grave and killed, that the departed may appear well mounted and caparisoned among his fellows in the other world. Formerly, if the deceased were a chief or man of consequence and had large herds of ponies, many were killed, sometimes amounting to 200 or 300 head in number."*

An amusing story is told in illustration of the importance attached to the pony provided for the deceased in the happy hunting-grounds. An old chief died who was very poor, and had no friends or relations. The people thought

* Account given by Dr. Fordyce Grinnell, of Wichita Agency, Indian Territory, Bureau of Ethnol., p. 99. First Annual Report 1879–80 (Smithsonian Institution).

that any kind of a pony would do for him, so an old, dilapidated, lop-eared scraggy pony was killed at his grave. However, to their great astonishment, he returned a few weeks later on the same old pony, and he was worn out with hunger and fatigue. When the men of his tribe saw his hollow cheeks and sunken eyes they fled from him in consternation. He begged for food, and one bolder than the rest offered him a piece of meat on the end of a lodge-pole. When he appeared at his own camp, the Comanches and Wichitas fled in dismay to a place on Rush Creek. "When the troubled spirit from the sunsetting world was questioned why he thus appeared among the inhabitants of earth, he made reply that when he came to the gates of Paradise the keepers would on no account permit him to enter upon such an ill-conditioned beast as that which bore him, and thus in sadness he returned to haunt the homes of those whose stinginess and greed permitted him no better equipment. Since then no Comanche has been permitted to depart with the sun to his chambers without a steed which in appearance should do honour alike to the rider and his friends.' *

The body is buried on the western side of the camp, that "the spirit may accomplish the journey to the setting sun beyond." It is supposed among the Comanches that the spirit starts on its journey the following night.

Among the mourning observances of the Comanches are many strange customs differing from those of other tribes. Instead of the property of the deceased being disposed of among the relations, it is all destroyed or buried in the ground. It is believed that when the goods are burnt they ascend to heaven in the smoke, and will thus be of service to the owner in the other world. "Immediately after death, the relatives begin a peculiar wailing, and the immediate relatives of the family take off their customary apparel and clothe themselves in rags, and cut themselves across the arms, breast, and other portions of the body, until sometimes a fond wife or mother faints from loss of blood.† This is also customary among the Dacotah Indians. A missionary at Fort Snelling related the story of a woman who had lost a brother. With her friends she set up a most piteous crying, or rather wailing, which continued during all the night. She would keep on repeating the words which in English would mean, "Come, my brother, I shall see you no more for ever." Next morning preparations were made for the ceremony of cutting their flesh. The thermometer was at ten to twenty below zero, and the snow lay thick on the ground. However, a space was cleared, in the centre of which a very small fire was kindled, not so much for warmth as to cause a smoke which would ascend to the land of the setting sun. The sister and three other women came out of her lodge barefooted, and nearly naked, and all three began wailing and crying. They cut their knees and ankles with sharp stones, and one poor woman made more than a hundred gashes in her flesh. She was thoroughly exhausted with pain, loss of blood, cold, and long-continued fasting, and soon she sank on the frozen ground, shivering from the cold, and moaning with pain. She appeared frantic with grief; but it is not easy to imagine what benefit she expected for herself or her dead brother in return for this self-inflicted torture.‡

I may quote in conclusion the following translation of Schiller's burial song, believed to have been written by Bulwer:

See on his mat, as if of yore,
How life-like sits he here,
With the same aspect that he wore
When life to him was dear.
But where the right arm's strength, and where
The breath he used to breathe
To the Great Spirit aloft in air
The peace-pipe's lusty wreath?
And where the hawk-like eye, alas!
That wont the deer pursue
Along the waves of rippling grass
Or fields that shone with dew?
Are these the limber, bounding feet
That swept the winter snows?
What startled deer was half so fleet?
Their speed outstripped the roe's.
These hands that once the sturdy bow
Could supple from its pride,
How stark and helpless hang they now
Adown the stiffened side!
Yet weal to him! at peace he strays
Where never fall the snows,
Where o'er the meadow springs the maize
That mortal never sows;
Where birds are blithe in every brake,
Where forests teem with deer,
Where glide the fish through every lake,
One chase from year to year!
With spirits now he feasts above;
All left us, to revere
The deeds we cherish with our love,
The rest we bury here.

* First Annual Report, Bureau of Ethnology, Smithsonian Institution, 1879–80, p. 100.

† *Ibid.*

‡ Neil's "History of Minnesota," p. 445.

FIGURE OF THE MILKY WAY IN SPACE.

By Richard A. Proctor.

NINETEEN years ago* I wrote a paper called "Notes on Star-streams," in which I discussed the relations presented by the Milky Way, looked upon as in reality a star-stream and not the mere projection on the celestial sphere of a widely extended disc of stars. I endeavoured to show that although Sir W. Herschel's view respecting our galaxy was perhaps the only one which he was justified in forming when prosecuting his celebrated star-gaugings, it is yet one which is far from being in accordance with the information which he himself gathered for us, and is still further opposed by the facts which Sir John Herschel observed during his survey of the southern heavens. And I dwelt in particular on the evidence which the strange convolutions of the Milky Way, its narrow necks or isthmuses, the knots or clustering aggregations upon it, and still more the circular gaps which pierce it, afford respecting its structure. These point to the conclusion that whatever the Milky Way may be, it is certainly not what Sir W. Herschel had supposed. But I was forced at that time to admit that the problem of suggesting the real configuration of our galaxy was more than I could manage. Its complexities seemed unintelligible; though I did not wholly dismiss the hope of discovering a tolerably simple solution of the difficulties which presented themselves. "I may, perhaps," I remarked, "return on some future occasion to the consideration of the subject." When I thus wrote I was in hopes that the apparently intractable windings of the galaxy, as exhibited to us in the drawings of Sir John Herschel, would have been long ere this reduced into something like order.

* "Intellectual Observer" for August, 1867. This paper was written, however, seventeen years ago. I found it along with the letters of Sir John Herschel published in the first and third numbers of the present series of *Knowledge*. The paper and the illustrations appeared to me worth preserving in connection with Sir J. Herschel's letters.

For I must admit that it seemed to me as though our astronomers had been wilfully increasing the difficulty of the problem by the perverse way in which they had chosen to regard it. It was well fitted to the noble genius of Sir Wm. Herschel to take a wide view of the sidereal scheme. Indeed, standing where he did when he first attacked the problem, he had no choice but to select the more obvious and general features of the stellar scheme for his consideration. But as he progressed with his work he gradually began to modify many of the views which he had formed when the work was commencing. Or rather I should perhaps say that he began to test the general principles on which he had been compelled to base his inquiries. And there are few more interesting subjects of study than the gradual progress by which our great astronomer made his way from one point to another, until towards the end of his life he seemed preparing to lay before the world views which, while the direct fruits of his earlier hypotheses, were yet altogether opposed to them.

The work which the elder Herschel has thus carried so nearly to its completion fell into no unworthy hands. Sir John Herschel, inheriting his father's grand powers of generalisation almost undiminished, possessing also a capacity for laborious and far-sighted observation altogether equal to his father's, and a more thorough acquaintance with mathematical modes of reasoning, seemed capable of pushing the theories of the universe to that point which I believe they would most certainly have attained had Sir Wm. Herschel lived a few years longer.

But there was, I think, a difficulty in the way. The feeling I have when I rise from the perusal of any of those noble passages in which the younger Herschel presents or discusses the views formed by his father is, that he has been at times prevented from prosecuting inquiries which seem opposed to the general direction of his father's researches, by a feeling—very natural and amiable—of respect for his father's work and fame. I could point to many passages which seem to me to force this view upon us, but I will content myself with noticing two singular illustrations.

Sir John Herschel is describing the configuration of the Milky Way in the southern heavens. He has occasion to speak of the striking brightness of the galaxy in the southern skies. Now it need hardly be remarked that on Sir W. Herschel's theory of the galaxy this great brightness is very difficult of explanation. That this is so, in fact, is proved by this, that, whereas Sir John Herschel felt that we could only explain the phenomenon naturally by supposing our sun to be nearer this part of the Milky Way, Professor Grant points out (very justly) that on Sir William Herschel's theory the phenomenon requires that the sun should be nearer to the opposite part of the Milky Way, for on this supposition alone would the number of stars towards the south be greatest. Sir John Herschel gives the obvious explanation, however; and he seems to feel how strongly it is opposed to his father's theory, for he adds that the galaxy "*on this view of the subject would come to be considered* as a flat ring of immense and irregular breadth and thickness, within which we are eccentrically situated nearer to the southern than to the northern part of its circuit." Yet he nowhere adopts this view. I feel certain that had the disc theory of the galaxy been due to any but Sir W. Herschel, the observation would have led the younger Herschel to adopt at once and finally the ring theory, though I believe he would soon have seen reason to modify his opinion of the ring's shape and figure.

Again, Sir John Herschel is discussing the Magellanic clouds. He is impressed with the evidence they seem to afford of the fact that, within very moderate limits of distance, the faintest telescopic stars and nebulæ of all degrees of irresolvability may be mixed up with stars of the eighth and ninth magnitude. Nay, he points out in his own lucid manner that, according to all the laws of probability, we must look on this fact as established beyond dispute. He sees also, as in the preceding instance, that this view is altogether opposed to accepted views respecting the universe. Yet he closes the discussion of the overwhelming evidence thus afforded against one of the most striking of his father's views with the simple remark that, "It might lead us to look with some doubt on conclusions which in former pages of this work have been somewhat positively insisted upon." A certain fact is proved beyond all question, yet in the remaining pages of the "Outlines of Astronomy" that fact is completely ignored.

Even as it is, Sir John Herschel's views respecting the galaxy are marked by a certain advance upon his father's. Although not definitely adopted, we must look on the ring theory of the Milky Way as that which the younger Herschel held in preference to the disc theory.

Now, it will be noticed that wherever Sir John Herschel has occasion to refer either to the narrower portions of the galaxy or to the branches which appear to extend from it, he always exhibits a preference for the view that these narrow star-beds are in reality the side views of widely extended star-strata. He says, indeed, in one place, speaking of a region where several branches of this sort are visible, "it is obviously more reasonable to suppose that these are sheets of stars viewed edgewise, than to imagine they are real columnar excrescences, bristling up from the general level."

I think we must recognise in this peculiarity the influence of the preconceived opinion that not merely our sidereal system but all the parts of it exhibit a certain tendency to lateral extension, so that the existence of a columnar star-group, or of what I should prefer to call a star-stream, is improbable *à priori*. Otherwise, I confess I am unable to conceive how his intimate acquaintance with the principles of probabilities could have failed to enforce upon Sir John Herschel the feeling that the many long and narrow streams which he saw extending from various parts of the galaxy must in most instances, if not in all, be *columnar*. Nay, even with preconceived views rendering the estimated chance of the existence of galactic star-streams only $\frac{1}{100}$, yet the existence of two such streams would have balanced that *à priori* improbability, since we can hardly estimate at more than $\frac{1}{10}$ the chance of a sheet of stars being seen edgewise, and therefore the chance of two being so seen would be only $\frac{1}{100}$. Now, Sir John Herschel saw *many* such excrescent streams.

It will be seen at once that the existence of small streams extending from the galaxy goes far to prove the stream-formation of the galaxy itself. When this evidence is added to that which I adduced in my former paper, the conclusion seems to me to be altogether obvious that the apparent stream of milky light which we term the galaxy is in reality a stream of small stars, surrounding us on all sides.

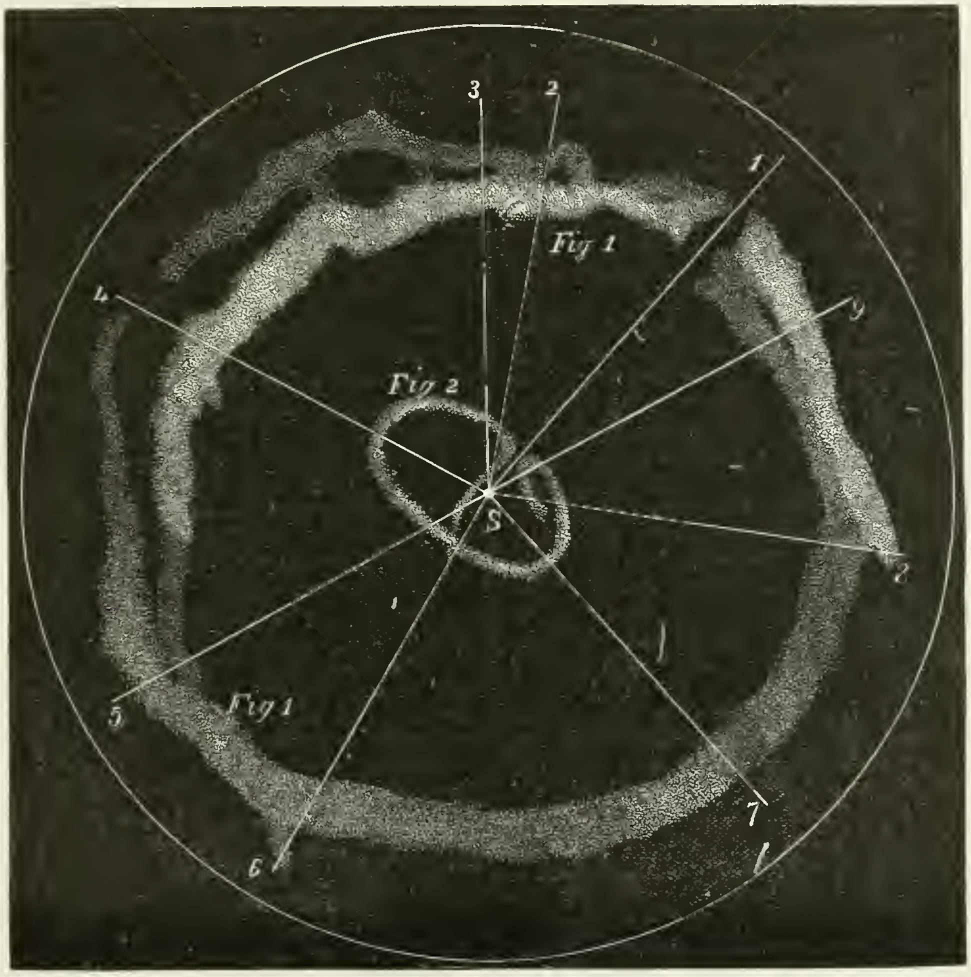
But I would go further, and assert that the naked-eye appearance of the Milky Way is sufficient evidence on which to ground the belief that there is a distinct ring of matter out yonder in space, and that this ring is not flattened, as Sir John Herschel thought, but is (roughly speaking) of nearly circular section throughout its length. I conceive that nothing save the perverse way in which astronomers have chosen to deal with the phenomenon would ever have led them to forget the evidence of their senses in this matter. Of course, if we insist on taking the average number of stars visible on a certain space of the heavens as indicating the density of the stars over that space, although it is perfectly obvious to the eye that there is a distinct and systematic

arrangement of the stars there wholly negativing our initial supposition, we must expect to be misled. With all respect for the elder Struve's labours, I must admit that this seems to me to be what he has done in his famous distribution of the stars according to zones of given galactic polar limits.

Consider, however, fig. 1, which represents the galaxy as actually seen in the heavens,* and it becomes wholly impossible to believe that we have to deal with the projection upon the celestial sphere of a widely-extended cloven disc of stars. The view does not account for *one* of the peculiarities of the galaxy proper, however justly it may seem applicable to the sidereal system. The great break in Argo (opposite line 1 in our figure) is of itself sufficient to negative the disc theory; so is the coal-sack near Crux, and so are the somewhat similar vacancies in Cygnus and Argo. The fact, too, that the second stream (which has led to the assumption that the sidereal disc is cloven) is not continuous, is one which cannot possibly be explained on the disc theory.

But, although one may feel convinced that the galaxy is really a stream of relatively small stars surrounding our heavens, it has always seemed to me a very difficult matter to account for the various phenomena presented by the Milky Way on any reasonable hypothesis. It was easy to see that, whatever hypothesis we adopt, we must be prepared to admit of the existence of great irregularities. In fact, as such a stream as I conceive the Milky Way to be would be subject to a number of attractions, swaying its length here in one direction, there in another, those irregularities were to be looked for independently of any considerations founded upon the observed appearance of the Milky Way. But there were certain features which I felt that any hypothesis for which support could reasonably be claimed ought to explain.

The difficulty I found was in conceiving how, first, the *interruptions*, secondly, the *variations of brilliancy*, and thirdly, *lacunæ* in the Milky Way, could be accounted for by any single stream however shaped. An explanation, which accounted for the interruption opposite line 1, left the interruption opposite line 2 unaccounted for. Again, I did not find it easy to account for the sudden access of brilliancy at 8, the extreme faintness at 7, or the fact that of the two branches starting from 5 the fainter becomes presently the brighter, and *vice versâ*. The three coal-sacks also were a great mystery to me.



I have again and again attacked the problem (which now seems perfectly simple and easy) without being able to imagine a stream of reasonable figure which would account for these peculiarities.

At length (more than two years after I had come to the conclusion that the galaxy is really a spirally formed ring of generally circular section, by looking on the break opposite

* The mode of projection must be conceived to be as follows:—Suppose that on a celestial globe a band is taken, including the whole of the Milky Way, and that this band is spread as a long, straight slip on a plane surface. If, then, we conceive the band turned into a circular strip, from the uniform contraction of one edge, we shall have such a map as fig. 1.

as due to increase of distance, not to a real interruption of continuity, I was able to construct a single spiral curve which seems completely to meet all the requirements of the problem. This curve is exhibited in fig. 2, which is supposed to exhibit the actual figure of the galactic spiral in space. It is so situated that the various lines drawn from our sun, supposed to be at S, intersect the various portions of the figure representing the real galactic stream, opposite the regions in which these lines meet the figure of the galaxy on our heavens.

We see that line 1 passes through a gap between the two loops of the galactic spiral. This seems (to begin with) a simple explanation of what has hitherto been admitted to be one of the most perplexing features of the Milky Way. Passing to position 2 the line crosses two branches of the curve, and the coal-sack is accounted for by the deviation of one branch (or both branches) slightly from the mean galactic plane. From position 3 the line crosses one branch at a very small distance, the other being much farther off. This corresponds closely with the appearance of the two branches, the continuous one being very much the brighter, and some portions along this part of its length being described by Sir John Herschel as singularly bright. It is also well worthy of notice that the two stars which are nearest to the sun (so far at least as observation has yet shown) lie along this branch of the galaxy—α Centauri very nearly where the branch approaches closest to the sun, 61 Cygni in direction S5, where the branch is some three times farther off.* The farther branch attains, along S4, so great a distance from the sun as to become invisible. This corresponds with the *mode* of the discontinuity of this part of the Milky Way, for each end of the broken division *loses itself*, not terminating abruptly like the two fan-shaped terminals opposite the line S1.

Near this portion of the circuit we are provided with an explanation of what had always been looked upon as a great difficulty. Where the two branches start from the coal-sack in Cygnus (on S5), the northern branch is much the brighter, but presently the northern branch grows fainter and ultimately vanishes, while the southern grows brighter and brighter. This is fully accounted for by the figure I have assigned to the spiral.

The projection at 6 may be accounted for by assuming the end of the spiral to be curved backwards as I have shown it.

Lastly the faintness at 7, the projection at 8, and the vacuity at 9 are obviously accordant with the figure given to the end of the spiral which falls opposite the lines to these parts.

Without asserting that the actual figure of the galaxy in space is that shown in fig. 2, I yet think it probable that the order of its windings resembles that shown in the figure. I believe, however, that there are many irregularities not merely in the direction in which the spiral extends through space along its general plane, but in directions inclined to that plane. The appearance presented by the Milky Way in Aquila and Scorpio is strongly suggestive of such peculiarities in the real figure of the spiral.

I feel convinced, further, that the study of the Milky Way as presented in fig. 1 will at once dispose of the notion that the galaxy can be either a cloven disc or a flat ring, or that the section athwart any branch of it can be otherwise in general than roughly circular.

"The fool hath said in his heart, there is no God." It takes another kind of fool to add, "except my God." The wise alone know that "a God understood would be no God at all."

---

* According to the annual parallaxes assigned to these stars, 61 Cygni is between two and three times as far from us as α Centauri.

ANIMAL WEATHER-LORE IN AMERICA.

By Charles C. Abbott, M.D.

HAPPILY there still remain a few of those great, cavernous, open fireplaces, flanked by high-backed settles, whereon the young people love to lounge while their elders, resting from the day's labours, talk drowsily of old times, recount the adventures of their youth, and repeat the tales of their grandfathers. As one of such young people I have passed many long winter evenings listening eagerly to what the septuagenarians might relate, and occasionally venturing a question or two that more light might be thrown upon obscure portions of remarks made at the time. Then, particularly, are we likely to hear much of that very curious animal weather-lore that for the past two centuries has been handed down from father to son. Time and again, as the weather chanced to be discussed, I have heard some uncouth rhyme repeated, usually prefaced with the remark, "You know the old saying."

That all animals are more or less affected by coming atmospheric changes is unquestionable. This simple fact has been recognised the world over, but, unlike many other simple facts, has not resulted in leading to any important discoveries. It has, however, given rise to the innumerable sayings to which I have referred.

Inasmuch as the animal weather-lore current in England and Sweden dates far prior to the settlement of this country by the Swedes and English, it would seem probable that such sayings as now are or recently were current in South and Central New Jersey are merely adaptations of English and Swedish weather-lore to our fauna, just as the European names of the commoner birds found there were applied to those American species most closely resembling them; and so any rhyme or brief saying referring to them would be applied to the analogous bird found here (in America). This is eminently reasonable, for if the given habit, voice, or other peculiarity of a European bird did, or was supposed to, indicate a given meteorological condition, the same rule should hold good in America. As a matter of fact, however, I can find no similarity between the English and Swedish and the American weather-lore, except such as applies to domestic animals; nor do I find any common English sayings in use.

That which I have heard, and have recorded from time to time, appears to have originated where [it is] now, or where it lately was, in use. To a great extent, I believe it to be original with the descendants of the immigrants that settled Central New Jersey and the country generally about Philadelphia; but a portion of it, very possibly, was derived from the Indians.

At present, a portion of this weather-lore is repeated as nursery rhymes, and it is due to this that it has been preserved to the present time; and, so far as I have been able to determine, not one of the rhymes or sayings has ever been published. That among the earliest papers and almanacs of the country there may be found some of them, or slightly different versions of the same, is probable, but my searchings therefor in the larger libraries have not resulted in any such discoveries.

The main interest, however, in connection with weather-lore is to determine whether the sayings do or do not correctly represent the relationship of the animals mentioned to the given condition of the weather. In other words, is the zoology of the weather-lore misrepresented or not? I am forced to declare that, as a rule, those who by virtue of their ingenuity framed these rhymes and brief sayings did not correctly interpret Nature.

Very many of the early English settlers were, no doubt, excellent observers; but they appear at times to have more desired to be looked upon as weather prophets than as naturalists, and strove to have glib nonsense-sayings pass current as evidence of their wisdom, instead of taking pains to correctly interpret the course of Nature and determine the relation of animal life to its environment.

Often during my rambles in the neighbourhood I have questioned the few remaining descendants of the original settlers concerning the local weather proverbs, and I find the impression is still prevalent that the purport of all these sayings is substantially correct, and therefore, to a great degree, that my neighbours are labouring under erroneous impressions. "Is there not wisdom in a multitude of counsellors?" they ask; and I, standing alone, am voted the fool, while they pose as sages.

Let us consider this weather-lore, bit by bit, as I have gathered it from time to time, and discuss its merits, if it possesses any, and also its absurdities.

Of such sayings as refer to our domestic animals, the following are the most noteworthy. Of the cow I have heard it said:—

> When a cow tries to scratch its ear,
> It means a shower is very near;

and again:—

> When it thumps its ribs with its tail,
> Look out for thunder, lightning, hail.

As is now pretty well known, a short time before a shower in summer there is often a highly electrical condition of the atmosphere which makes all animals more or less uneasy. Therefore the lashing of the tail, if not merely to brush away flies, may refer to this uneasiness, and so, too, the ears may be more sensitive than the general surface of the body. This is a probable explanation: but, after all, it is not proved that the cow at such a time suffers as much from it as is supposed; nor is it easy to see how the flagellation of a very insignificant part of the body can ease a painful sensation common to the entire surface. On the other hand, it is certain that flies and other troublesome insects are sensitive to atmospheric changes, even a slight lowering of the temperature, such as no mammal would appreciate; and for an hour or two before a shower, for this reason, they congregate in extraordinary numbers about animals—horses and cows particularly. I have thought that they seek the cows for warmth when the air suddenly cools; and is it not more than probable that the nervousness on the part of the animal, shown by frantic efforts to scratch its ears with its hind-feet and the lashing of its tail, has to do with the excess of irritation caused by innumerable flies, and not with any unusual electrical titillation? If so, the cow's action is still indicative of an approaching change in the weather, and so far may be claimed as a sign of such change. but the connection of the two facts is not such a one as is usually given. It is an indirect, not direct, indication of the prophesied rain-storm. But bearing heavily on the subject is the unquestionable fact that an unusual number of flies often suddenly make their appearance, and torment cattle almost beyond endurance, during the four or six weeks of drought which in summer, early or late, we are so sure to have. In such cases the signs fail. I have asked many a farmer how this could be, and the one reply that I have received in every case is that "there was a shower in the neighbourhood." It usually happened, however, that the neighbourhood was as parched as we were, and seeing the signs fail with them, they were covetous of the shower they supposed that we had had. Perhaps it is with such indications of changes in the weather as it has been said of autumnal proofs of the character of the approaching winter. Miles Overfield once remarked, "When the signs get to failin' 'long in the fall, there'll be no tellin' about the winter."

Of pigs, I have heard it said very frequently—

> "When swine carry sticks,
> The clouds will play tricks";

but that—

> "When they lie in the mud,
> No fears of a flood."

The first of these couplets is of twofold interest. I have watched pigs for years to see what purport this carrying of sticks and bunches of grass might have, and have only learned that it has nothing whatever to do with the weather, or at least with coming rain-storms. The drought of summer is so far a convenience as to throw light upon this habit, as it did upon the uneasy cows. Pigs carry sticks as frequently then as during wet weather, or just preceding a shower. Furthermore, these gathered twigs are not brought together as though to make a nest, but are scattered about in a perfectly aimless manner. For some cause the animal is uneasy, and takes this curious method of relieving itself. The probabilities are that it is a survival of some habit common to swine in their feral condition, just as we see a dog turn about half a dozen times before lying down.

In an interesting paper on local weather-lore, read by Mr. Amos W. Butler before the American Association for the Advancement of Science, during the Philadelphia meeting of 1884, the author has another version of this saying: "When hogs gather up sticks and carry them about, expect cold weather." This is wholly at variance with what I have observed, for my memoranda record this habit almost wholly during the hot weather, and this must necessarily be the rule with New Jersey swine, or the local weather-prophets would not have coined the verse as I have given it.

As to the other couplet, it is about as near meaningless as any saying can well be. Some rustic rhymer, a century ago, may have added it as a piece of fun, but it has stuck most persistently. As it stands now, it has stood for quite one hundred years.—*Popular Science Monthly.*

(*To be concluded.*)

THE RACES OF BRITAIN.*

THIS is what the seventeenth century writers would have approvingly called a "painful" book, as when Jeremy Taylor speaks in praise of Tostatus Ambulensis as "a very painful person and a great clerk." For the collection of the materials tabulated and illustrated in Dr. Beddoe's work has involved an appalling amount of labour, to which small hope of large recognition and speedy result could give impetus, but only the desire to lay the foundation for a scientific treatment of the profoundly interesting, but long confused, study of the ethnography of Britain.

The subject is even now not altogether out of the hands of the "fadicals." Despite Mr. Elton's scholarly and delightful "Origins of English History," Mr. Green's attractive but less authoritative "Making of England," and the more modest but accurate manuals prepared, at the instance of the Christian Knowledge Society, by Mr. Grant Allen,

* "The Races of Britain: a Contribution to the Anthropology of Western Europe." By John Beddoe, M.D., F.R.S., &c. Bristol Arrowsmith.

Professor Rhys, and others, there are still left enough eccentric people to support the "Anglo-Israel" craze, with its organs in advocacy of the descent of the British from the Lost Ten Tribes, and of the national lion as the equivalent of the Lion of the Tribe of Judah. Like the Ephraim with whom they claim kinship, such folk are "joined to their idols; let them alone."

The judgment of sound ethnologists that there are no pure unmixed races in Europe applies to these islands in marked degree, the history of their peoples being one of continuous intermingling, possibly, as Dr. Beddoe hints, from late palæolithic times, and certainly from earliest neolithic times, to this day. The Celts of Cæsar, the "ancient Britons" of our obsolete school-books, were not aboriginal; and perhaps the earliest historical reference to races preceding them as immigrants is in that of Herodotus to the Kynesii (which word, probably meaning "dog-men," may be the Greek equivalent for a totemic tribal name), as "dwelling the furthest away towards the west of the inhabitants of Europe," races leaving their mark in relics both material and intangible—in tomb and tumulus and superstitions miscalled "Druid," really the Shamanism of the west—and whose blood yet runs in the veins of swarthy men and women scattered over these islands, especially along their western shores.

Dr. Beddoe, dissatisfied with conflicting accounts of racial characteristics due to casual observation, and with the doubtful nature of evidence as to race-connexion based on the shape of skulls, has devoted the available leisure of over thirty years to measuring the heads, noting the colour of eyes and hair, and the stature and bulk (the details of these last-named not being included in the volume under review) of hundreds of thousands of people of both sexes, and of all ages and conditions of life, from John o' Groat's to Land's End, and has then compared his records with results obtained on the continent, especially among races having most in common with our own. The course of true inquiry does not always run smoothly, and even the promise of money sometimes failed to overcome the scruples of the owner of the head to submit to the measuring test. The natives of Kerry seem to have been especially obstinate, perhaps through superstitious dread akin to that which makes savages afraid of having their likenesses taken, and Dr. Beddoe tells by what ruse he and his comrades succeeded:—

Whenever a likely little squad was encountered, the two archæologists got up a dispute about the relative size and shape of their own heads, which I was called in to settle with the callipers. The unsuspecting Irishmen usually entered keenly into the debate, and before the little drama had been finished were eagerly betting on the sizes of their own heads, and begging to have their wagers determined in the same manner.

Dr. Beddoe divides his work into sections corresponding to race movements in these islands, using with becoming caution the evidence which language and place names supply concerning the area and range of immigrations, all this being prefatory matter to the elaborate tables and maps on which his conclusions as to the several proportions of blonde and dark peoples are based. His scientific temper is shown in the "inconclusions" added to the final chapter.

Certainly the main interest of the book gathers round the question, hinted at above, of the persistent admixture of a Mongoloid element in Britain, an element of which the most notable indications are the oblique or Chinese eye with its almond-shaped opening, and thickness of the upper eyelid. Its presence is fatal to the easy-going theories of historians who have cleared the ground by assuming the extermination of conquered races, and a purely Teutonic element in English and Lowland Scots. It throws faint, yet welcome, light on the very obscure movements of prehistoric races across the Eurasian continent, whose semi-civilisation is the substratum, now and again obtruding or overlapping, of both Aryan and Semitic culture. Dr. Beddoe's work is therefore to be commended both to the ethnologist and the historian. The one will find its data indispensable in considering the influence of interminglings and consequent subtle variations before he determines his racial types; the other cannot ignore those data if he would satisfactorily explain the great race-movements which have affected the destinies of empires.

MARS AND JUPITER.

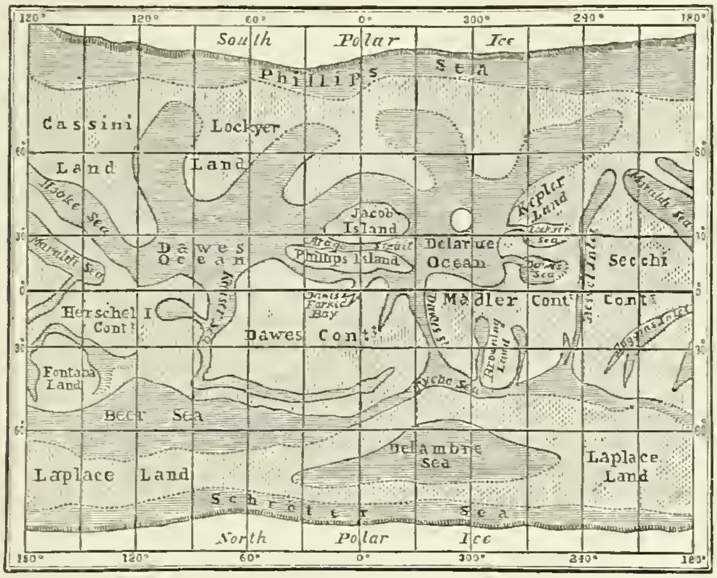
By Richard A. Proctor.

We present this month four views of each of the planets which are now shining so conspicuously in our skies, besides a map of Mars and a separate view of Jupiter, showing the giant planet as he appeared before the recent remarkable phenomena in his southern hemisphere had shown themselves (or had returned ?).

The two upper views of Mars show the planet as drawn by Mr. Trouvelot, at Harvard, in 1877; the two lower ones show Mars in nearly the same aspects, as drawn at the same opposition, by Mr. Nath. Green, at Madeira. It is hardly necessary to tell the reader that the present aspect of the planet is very different from that which Mars presented in 1877. The student will have no difficulty in applying the construction I gave in Knowledge for February 1, 1884, to obtain suitable projections of the meridians and parallels of Mars as now posed with respect to the earth; and, by filling in details from the accompanying map, he can obtain any number of projections of the planet itself. For the present I have not thought it necessary to alter the map to correspond with the improved nomenclature suggested by Mr. Green. As the names I gave the continents and seas were merely intended for reference in books of my own, not at all for general employment, and as they still serve their original purpose, I let them remain for awhile. But a certain silly idea started among the weaker-minded that these Martian names were things to be craved! Wherefore I incline to think that the sooner indifferent names are substituted the better. Schiaparelli, of Milan, has gone in for something of the sort; but, as none but scientific prigs could use his classically sesquipedal names, the thing will have to be done over again. For mere reference any Martian names will serve very well—the more indifferent the better; only we must be careful to prevent any Martian combination akin to the Birt-Webb-Neison ring (*vide* future section of "Americanisms") in the moon.*

The four views of Jupiter illustrate the varying aspect of the great spot since 1870. When the latest were obtained it was supposed that the spot was about shortly to disappear; but it has latterly resumed something of its former conspicuous appearance.

* I do not at the moment know whether that unknown family-party, introduced by Mr. Birt into the lunar maps, which aroused the wrath of Prof. Simon Newcomb, has yet been eliminated, but hope it has. Some astronomers have odd weaknesses this way. An American astronomer used to give to asteroids which he discovered names in honour of the ladies to whom he successively lost his heart. Fortunately—since his heart was rather readily lost—he discovered nearly enough asteroids to go round (the only asteroidal rotation yet recognised).



Jupiter in 1856 (De la Rue).

Mars in 1877 (Trouvelot).

Great Ring in 1870

Great Spot in 1877

Mars in 1877 (N. Green).

Great Spot, May 17, 1883.

Great Spot, Sept 10, 1883.

THE HUNDRED BOOKS.

MR. STEAD having succeeded to his satisfaction in disclosing the amount of iniquity which underlies the respectable Pharisaism of British society, has not been content without further efforts in the direction of of mask-removing. He has appealed to numbers of persons who were supposed to have a certain amount of common-sense, and has succeeded in making a goodly percentage show themselves to be prigs "of the first water."

From all this mass of clotted conceit, it is refreshing to be able to select a few specimens of common-sense, touched by a humorous sense of the absurdity of the whole matter.

Thus, for example, does Mr. James Payn poke sly fun at Sir John Lubbock and his list:—"I have a great respect for Sir John Lubbock, but I do not agree with him as to systematic reading. When a particular object has to be attained reading cannot be too special; there is an enormous waste of intelligence through a neglect of this fact; but otherwise reading should 'come by nature.' When I read through the list of books you send me, I cannot help saying to myself, 'Here are the most admirable and varied materials for the formation of a prig.' There is no more common mistake in these days than the education of people beyond their wits."

In a lighter vein, Mr. Burnand indicates, with equal clearness, his opinion of the issue of these lists of books. *Punch*, by the way, gave a charming illustration, in the days of dear old Leech, of the priggishness of those who want to show that they have been educated "beyond their wits." "Mamma," says a hopeful young person of twelve or so, "I asked Mr. Harris and Miss Smith if they knew the principal events, and what great men flourished, in the seventh century before Christ: and they didn't, but I do, and——" she proceeds to cite Mangnall, to the horror of the community. The present editor of *Punch* cleverly castigates the hundred-book-man thus:—

"My Dear Sir,—How can I suggest any better reading than 'Happy Thoughts,' 'About Buying a Horse,' 'The Modern Sandford and Merton,' 'Strapmore,' 'One and Three,' 'More Happy Thoughts'?—Yours truly, F. C. Burnand."

Mr. Wilkie Collins, though at first, seeing the length of his reply to a question which ought never to have been asked, one supposes him to have joined the array of the prigs, writes very sensibly, especially in admitting likes and dislikes which they would reject with horror and disgust. Imagine the feelings with which a Ruskin, for example, would read a recommendation to enjoy "Peter Simple" and "Mr. Midshipman Easy," or the novels of Fenimore Cooper! But after all, the best thing in Mr. Collins's letter is the reference to the sound advice of Dr. Johnson: (how the good old boy would have roared his denunciation of the hundred-books nonsense!) "Never mind what I say," says Mr. Collins, "hear him. 'I would not advise a rigid adherence to a particular plan of study. I myself have never persisted in any plan for two days together. A man ought to read just as inclination leads him, for what he reads as a task will do him little good.'" As Captain Cuttle said of Bunsby, so say we with Mr. Collins of old Samuel, "Hear *him*."

Yet the results of this hundred-books absurdity have been useful; though not quite as intended. We have had excellent illustrations of the truth of Dr. Johnson's teaching, that those who read as a task get very little good from their reading. In such reading lie the materials for making, as we see, very first-class prigs. Then it is something that a writer so overweighed as Mr. Ruskin—outside his art criticism—should have been moved to disclose so much of his real nature. That list of Lubbock's scored by Ruskin tells a tale which even the admirers of his philosophy (so to call it) will not easily forget. The scoring out of Gibbon, Marcus Aurelius, Butler, Lucretius, Sophocles, Euripides, Grote, Mill, Darwin, Smith ("Wealth of Nations"), Descartes, Locke, Cooke, Longfellow, Hume, Macaulay, Emerson, Goethe, Thackeray, and George Eliot, speaks of a mind "much ill." (If all comparisons were not in our opinion as odious as the old proverb says, we might express the opinion, that to score out Thackeray and leave in Dickens, though it would be natural in a boy or girl or a person but half-grown intellectually, would suggest a mind which would set Sheridan Knowles above Shakespeare; but there would be this touch of unfairness in such a remark, that Dickens *has* reached the many, and that their love for him, though it indicates a lower type of excellence than Thackeray attained, shows at the same time that he had a special sympathy with the many, which in itself suggests an element of greatness.)

Among the "mixed criticisms" are included some of the very best. We quote the following as very good, and suggestive of a keen appreciation of the absurdity of the original idea:—

Professor Tyndall:—"The encyclopædic spirit of my friend Lubbock surprises me. If I could imitate him I should willingly lend you a helping hand, but I cannot."

Professor Jowett:—"I am afraid that I cannot add anything worth your having to Sir John Lubbock's list. It is a very good list, the chief fault being that it is too long."

Mr. Froude:—"People must choose their own reading, and Sir John Lubbock's list will do for a guide as well as others. I, at any rate, do not wish to put myself into competition with him."

Professor Freeman:—"I feel myself quite unable to draw up such a list as you propose, as I could not trust my own judgment on any matter not bearing on my own special studies, and I should be doubtless tempted to give too great prominence to them."

Sir Frederick Leighton:—"I have to own that my acquaintance with Philosophy and Letters is neither so wide nor so close as to furnish me with the materials for pronouncing, even if I had the faculty to determine, which hundred books, taken together, contain a liberal education."

The author of "John Halifax," Mrs. Craik:—"I always think readers know best how to choose their own books—what they like, and (equally important) what it is in their power to get."

Mr. Matthew Arnold:—"Lists such as Sir John Lubbock's are interesting things to look at, but I feel no disposition to make one."

Mr. Herbert Spencer:—"My reading has been much more in the direction of science than in the direction of general literature; and of such works in general literature as I have looked into I know comparatively little, being an impatient reader, and usually soon satiated."

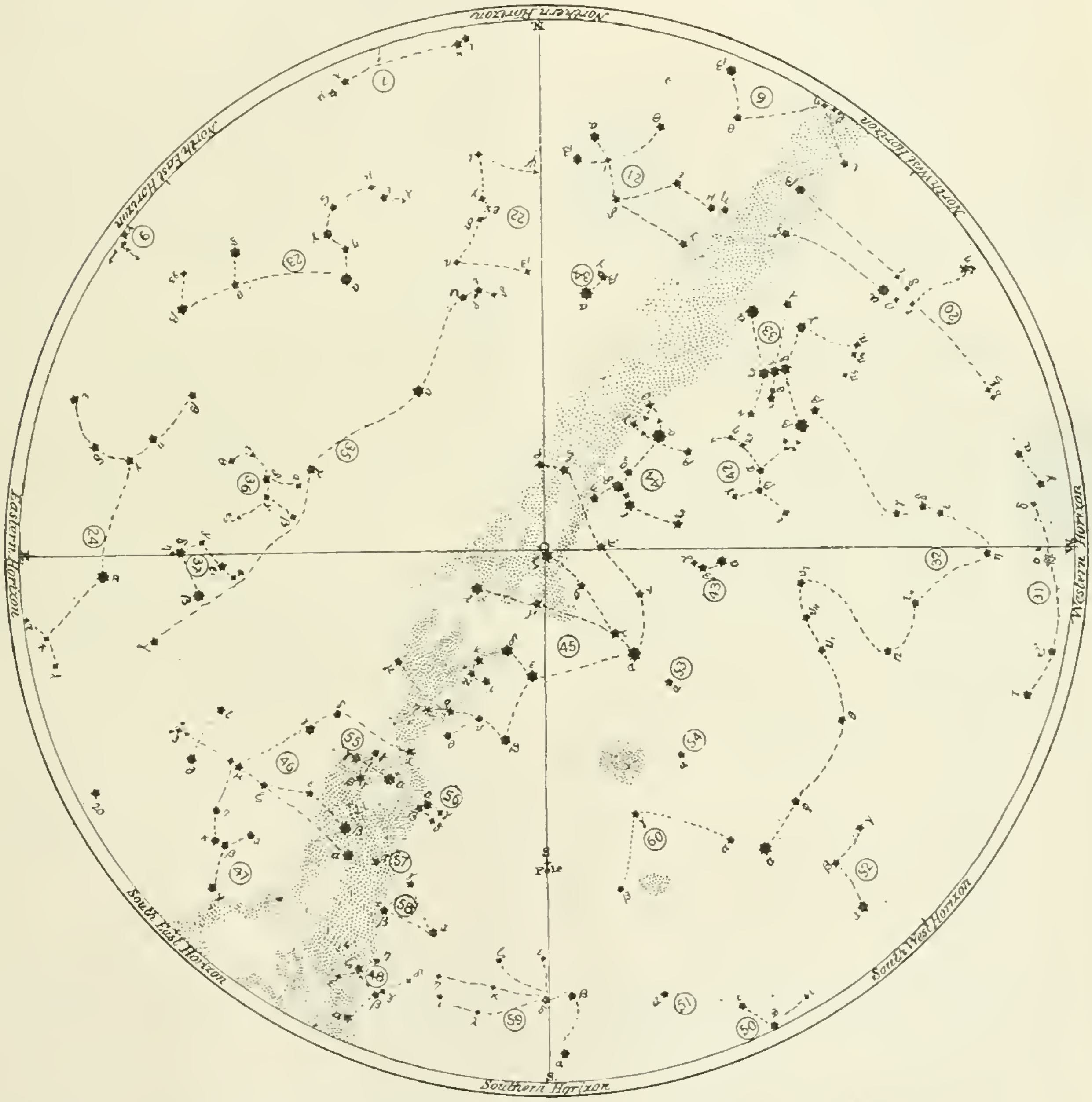
Panthers, Hyenas, and Jackals.—Twelve hundred panthers have been destroyed, 1,882 hyenas, and 27,000 jackals. The destruction of these creatures may safely be regarded as an unmixed benefit, though it would not be so were not civilisation extending so that the work of carnivorous animals in destroying the surplus population of the deserts and the woods is no longer necessary.—*Newcastle Weekly Chronicle.*

THE NIGHT SKIES IN AUSTRALIA, CAPE COLONY, &c.

AT last, I think I have hit upon the form in which the maps of the skies in the southern hemisphere will prove most useful. Yet must the map in the present number be regarded as only tentative.

It will interest the student of the heavens to note that the map which illustrates the skies of latitude 38° south, and is available for all places in the southern hemisphere between latitudes 30° and 45°, shows also the whole of the southern half of the sky, at the same hours, in latitude 52° north, or centrally for England. For the former use, that is for use in the southern hemisphere, the middle of the map marked O is the point over-head, and the circumference of the map represents the horizon. For use in the northern hemisphere the line E O W represents the horizon from east at E through south at O, and to west at W; while the point marked N is over-head, and the semi-circumference, E N W. represents the prime vertical.*

It seems curious to consider that that semicircle of the star sphere which forms our horizon from east through south to west at any hour is, on the same day and at the same hour of local time, a semicircle of the star sphere passing from east through the point overhead to west at a station 90° removed from us in southerly latitude. It would be a rather pretty problem in the astronomy of the late Parallax and of the still-flourishing Hampden, to show how stars which appear along a horizontal semicircle in England



THE SKY IN AUSTRALASIA: AND (UPPER HALF) THE SOUTHERN SKY IN ENGLAND, AT SEVEN O'CLOCK, APRIL 6.

* The points E and W are also overhead, the straight line N O S representing the horizon, for places on the equator six hours or three months later or earlier than the map dates.

can appear as a vertical semicircle in Cape Colony, the same stars appearing due east and due west respectively at both places. But the thing occurs, as I happen to have seen.

The Constellations are numbered as in my "Star Primer" up to 46 (*Centaurus*). The remaining numbers indicate the Constellations nearer the South Pole, viz.:—

47. *Lupus*, the Wolf.
48. *Ara*, the Altar.
49. *Indus*, the Indian.
50. *Grus*, the Crane.
51. *Toucan*, the Toucan.
52. *Phœnix*, the Phœnix.
53. *Dorado*, the Sword-Fish.
54. *Reticulum*, the Net.
55. *Crux*, the (Southern) Cross.
57. *Circinus*, the Compass.
58. *Triangulum*, the (Southern) Triangle.
59. *Pavo*, the Peacock.
60. *Hydrus*, the Water-Serpent.

The student may find it interesting to compare the alternate maps of my "Star Primer" (where twenty-four maps are given, instead of twelve only, as in the southern series and my "Half-hours with the Stars") with those now appearing here, which are on the same plan and scale.

WHIST AS A RECREATION.

By "Five of Clubs."

I ATTACH great importance to the development of good games, whether outdoor or sedentary. By good games I mean games which serve well the purpose of all games—to wit, recreation. Men engaged in arduous work, whether in study or in business, require rest and refreshment. Experience shows that to do nothing is not rest. The mind refuses to be idle, and the effort to make the mind do nothing is more arduous than many forms of hard mental labour. One might as well expect to repair the toil-worn body by mere idleness, without food and nourishment, as to rest the toil-worn mind by setting it simply at rest.

It has been shown by Dr. Paget that the element of "skill" is desirable in all forms of recreation, whether for the mind or for the body. It is essential, he points out, that there should be "opportunities for the exercise of skill in something which is different from our regular work." Again, a desirable element in recreation is "uncertainty." In our daily work we have so much sameness and routine, so little to interest us through surprise, and we know so well what the general progress of each day's work is to be, that the mind requires uncertainty, much as the body, when dried by long hours of hard toil, requires liquid nourishment.

For these reasons we see that among out-of-door sports those are most popular which combine both the elements of skill and of chance. Rowing and riding are better exercises than lawn-tennis, cricket, and base-ball; but as recreations they are not so good, because they depend chiefly on skill and practice, and possess no element of chance and uncertainty. In like manner, games which depend wholly on chance are inferior to those which also depend on skill—as roulette is inferior to bagatelle, and still more to billiards.

What is true of outdoor sports is true of sedentary home games. Apart from the gambling spirit, which has no real relation to recreation, and is rather a relic of savagery than a normal development in civilised communities, games of pure chance have little interest for grown persons. Children, to whom games are rather as business than as recreation, can find amusement in "Beggar my neighbour" and other card games in which skill plays no part. On the other hand, home games of pure skill afford no real refreshment to the tired mind. Many undoubtedly take interest in chess, which comes as near to being a game of pure skill as any that has yet been invented;* but those who love the game most find least recreation in it, unless, indeed, they play chess specially for recreation. And in passing I may note that I have found a way of getting much more "rest and refreshment" from chess than by any other plan I have ever tried. I had, indeed, given up the game as too taxing till the new plan occurred to me. It is this. I offer to mate my adversary (supposed of inferior strength, or made somewhat inferior by suitable odds) in so many moves—twenty, or twenty-five, or thirty, as the case may be—the game to count as a draw if won in more moves. This method affords a capital way of teaching the openings; for one may add the condition that such and such an opening shall be followed up to a given point. Thus I play, we will say, a couple of games with one of my boys, giving the Queen's Rook, and offering to mate within twenty-five moves, the opening to be played being the Evans's Gambit to the eighth move on a particular line. Doing this daily for a week, he learns that opening, and I get short and interesting games, the limited number of moves compelling brilliant play.

However, chess, even at the best, is open to serious objections as a form of home recreation. It is limited to two players. There are, indeed, certain dreary games known as "Chess for Three" and "Chess for Four," but they are not chess at all; and though consultation games may allow more than two players to take part in real chess, yet these are the profoundest and least restful of all forms of chess. Chess in any large gathering, or even in any home circle of moderate size, is undoubtedly a selfish game.

Card games, on the other hand, are not only better as recreation, they interest a greater number. The number of chess-players who play well enough to enjoy the game is small, in any company, compared with those who can enjoy good card games. By having several tables a large company can join even in such card games as euchre and whist, where, at the outside, four players only can take part in each game. All that is necessary to make card-play perfect as a recreation for those members of the company who really want recreation (not the young folks) is that the game played should combine in suitable degree the elements of chance and skill. In this respect whist stands unrivalled. Euchre is a livelier game, but it is shallow by comparison. "Progressive euchre" is simply, to my mind, an abomination of desolation. Piquet is nearly as scientific, but piquet is a more selfish game than even chess. "Poker"

* No one who has played much at chess will regard it as a game in which chance plays no part at all. For every chess-player must remember cases where his main attack has been foiled, yet, through some happy chance in the position of pieces advanced originally for an entirely different purpose, a new and brilliant attack may be opened, and the game won; or cases where an unforeseen attack may be foiled by the lucky position of a piece or pawn not set where it is with any idea that it might be so employed. How often, again, a pawn of one's own chances to be the only obstacle in the way of some otherwise sure assault on the enemy! Apart from this the surroundings have to be taken into account as affecting the progress of the game. I have won games entirely through the accidental disturbance of my opponent's mind by something which I chanced (*chanced* so far as the chess was concerned) not to care for; and I have lost and won games through causes similarly outside the game itself. I have won or saved games, again, through sheer chess accidents, and have lost games in a similar way. Yet, of course, in the main, skill is all in all at this royal game.

I regard as a game which might be excellent for recreation if it had not become essentially a gambling game, and fit only, as actually played, for cowboys and their kind. But whist is nearly perfect as a game of combined skill and chance. It is so good that it needs no such factitious excitement as money stakes supply. Indeed, a company of true lovers of this splendid game should be ashamed to play for money, just as two chess-players (outside the trained company of the professionals) would be ashamed to invite each other to contend for a stake. The only excuse for setting some small price on points at whist is that, where any of the players are not real lovers of whist, nothing but such an arrangement will keep them from spoiling the game by loose play, by talking of their hands, by telling their partner what they want him to do, and by running counter in other ways alike to the laws and etiquette of the game.

But whist, to have these good qualities, must be scientific whist, not mere play. A man may play what he calls whist for half a century and never know what whist really is. I played whist myself, evening after evening at home, and at college, and again on long sea journeys, for some thirty years—to wit, from the age of thirteen to that of forty-three—without getting any more recreation from it than the element of uncertainty without skill can supply. I do not say I did not find some exercise for memory and observation, or that occasionally, having learned from the most obvious indications of the play that the last three or four cards in each hand were so and so, I may not have correctly played from the position so reached. But this, when it happened, was the merest accident. In nineteen games out of twenty I was not playing whist at all. My excuse was that I knew no better. I played to complete the table, not for my own amusement. I had, indeed, conceived so much of a distaste for the game that I did not particularly care to learn from books what had been done in the way of combining skill with that element of chance which, like all other card games, whist possesses.

Whist properly played, however, is the best of home games. I reject the oft-quoted saying of Talleyrand in its favour, only because he said too little. To the young man who boasted that he played no whist Talleyrand replied: "Alas, young man, what a sad old age you are preparing for yourself!" But whist is worth more than to be a mere relaxation for old age. It is a game whose chief value lies in the service, *crede experto*, which it does for the busiest manhood.

Without considering the defects of what may be called family whist from a scientific point of view, it is obvious that the game is one of almost pure chance. Each player strives to make each good card in his hand as soon as he gets the chance. If he has a short suit, he tries to play out his cards in it, that he may trump the suit as soon as possible. His sole idea is to take advantage of the good cards or good features which chance has given to his hand. Of whist as thus played, the remark quoted by "Cavendish" in his "Card Essays" is sound—the game can be learned in a few minutes. "If that is the game," said a young man to whom the way of playing whist had been explained, "I can learn to play it as well as any one else in half an hour." That is actually the case. No one ever learns to play family whist better, after years of practice, than he did after his first fifteen or twenty hands—a tolerably good proof, if any were needed, of the monotony of the game, and its unfitness for the purpose of recreation.

Of real whist, on the other hand, Deschapelles, the finest player that ever lived (according to Clay, who was himself one of the finest, and had played with the great French master), said that years of practice are required even to teach a man how difficult the game is. A man may acquire the theory of scientific whist, indeed, and fall into the way of applying its principal rules systematically, in a few months. But years are required to make him a really fine player; and, even then, he finds that there remains room for improvement, until, after many years, he looks back on play which had formerly satisfied him as really far from the excellence he seems now to have acquired. Wherefore, while he may now regard himself justly as a good player, he will not—if he have noted the lesson from his past experience—regard his play as perfect, knowing that after a few more years he will recognise yet another advance.

THE SEA-SERPENT.

By Richard A. Proctor.

THERE is an interesting article on the sea-serpent in the *Cornhill Magazine*, bearing clear internal evidence of having been written by Mr. Grant Allen. In dealing with the sea-serpent, Mr. Allen calls into effective action a number of remarkable sea creatures, large enough and ugly enough to make the most hideous appearance when they condescend to ascend to the sea surface. The rhizodon, of the Indian and Pacific Oceans, a sharklike fish, is known to exceed fifty feet, and is said to have even measured seventy feet. The *Challenger* has dredged up from the Atlantic teeth of a shark which must have been nearly a hundred feet long—or rather, which must probably *be* so long as that, since it is altogether unlikely to have become extinct in the comparatively short period which has elapsed since the ooze was deposited in which the teeth were found. "Let us rest satisfied," he says, "with our big cuttle-fish and huge whales and monstrous sharks for the present; and whenever anybody catches us an enaliosaurian or a zeuglodon, or an immense marine snake, let us accept their new addition to zoology with all acclamation. Meanwhile, let us urge on all theorists, 'First catch your sea-serpent—then proceed to classify him.'"

The advice is, perhaps, not to the purpose. If anyone were to suggest that an Alpine peak ought to be brought to the sea level before geologists undertook to discuss its formation, the opinion would probably be that mountain peaks would remain for a rather long time unclassified. We are not very likely to hear of the actual capture of any of the great sea monsters which have been regarded as sea-serpents, any more than of those creatures, if such there are, which are actually serpentine, or lizard-like, or otherwise unlike sharks, whales, cuttle-fish, and the rest.

We may, however, for the present probably dismiss the zeuglodon theory of sea-serpents. Mr. Searles V. Wood regards the sea-serpent as a creature like a whale, and belonging to the same group as certain extinct toothed whales belonging to the Eocene period (the beginning of the tertiary era). These monsters ran to about fifty or sixty feet in length, and had most destructive fangs. It has been suggested that they were in reality a race in a state of transition from the seal-like to the whale-like character. They were originally land-dwellers, but had taken to the habit of swimming, till at last they came to resemble fish in outer form, though remaining warm-blooded air-breathers. But the theory that sea-serpents are (some of them) enaliosaurian is nearer to the evidence derived from their described forms. If we are to believe in some as yet unclassified sea-monsters at all, it seems on the whole simpler to recognise sea-serpents as enaliosaurian creatures (as they existed in ancient seas, with long necks extending from comparatively

small bodies, and using flippers as propellers), than to regard them as belonging to a race such as the zeuglodons, which do not seem to correspond anything like so nearly with the sea-serpent in appearance as the enaliosaurians must have done.

It is a pity that the average penny-a-liner never hears of the sea-serpent without attempting to be funny at the expense of the traveller who tells the story. For while it is certain, on the one hand, that we can never tell what the sea-serpent really is without obtaining all available information, it is certain, on the other hand, that few of those who may have information to give will tell their experience when they know that they will be exposed to ridicule. The mere fact that those who laugh at them are altogether contemptible makes the mischief greater, as the following story by "The Vagabond," a well-known Australian writer (I had the pleasure of meeting him in 1880), serves to show:—"Some years ago, Captain Austin Cooper and the officers and crew of the *Carlisle Castle*, on a voyage to Melbourne, saw 'the varmint.' A description and sketch of it were published in the *Argus*. This, when it arrived in London, it being the 'silly season' in journalism, was seized and torn to pieces by one of the young lions (that is, lion-skin-wearing asses) of the *Daily Telegraph*, in a leading article, in which much fun was poked at the gallant sailor. 'I don't see any more sea-serpents,' said my Irish friend to me. 'It is too much to be told that one of Green's commanders can't tell the difference between a piece of sea-weed and a live body in the water. If twenty serpents come on the starboard, all hands shall be ordered to look to port. No London penny-a-liner shall say again that Austin Cooper is a liar and a fool.'"

Between the idiots who invent silly sea-serpent stories, and the jeering boobies who conclude that all sea-serpent stories must be the work either of fools or of liars, men who have evidence worth listening to are silenced. It was bad enough when Professor Owen calmly suggested to Captain McQuhae, of the Government ship *Dædalus*, that he and his officers had been so frightened by the appearance of a strange sea creature as to mistake a sea-elephant, perhaps 20 feet long, for an animal of entirely different aspect and about 60 feet long. But he was at once put right, and by silence admitted that he had fallen (unwittingly) into impertinence. When, however, writers who have not been half-a-dozen years out of school undertake to tell experienced seamen that they are fools if they are not liars, *c'est par trop fort*, or, in the vernacular, one feels that that is "coming it a little too strong."—*Newcastle Weekly Chronicle*.

New Books to be Read (or avoided)—and Why.

A Time and Times: Ballads and Lyrics of East and West, by A. Werner (T. Fisher Unwin, London, 1886), because it contains some true poetry, and none of the maudlin stuff which self-styled poets are so apt to inflict upon us nowadays. Miss Werner's verses are graceful, nervous, and full of meaning, and many of the longer poems are suitable for recitation. As such may be mentioned "The White Witch of Perran Porth," "Bannerman of the Dandenong," and the two beautiful classical pieces, "Leaina" and "After the Battle." The contents of this little volume make one wish for more from the same pen.

Arminius Vambéry: his Life and Adventures. (T. Fisher Unwin. 1886.) The boy's edition of this popular book, which has already run through five other editions, was published by Mr. Unwin in time to be a welcome Christmas or New Year's gift to many an English boy, and will make a very acceptable school prize later on in the year. The autobiographer, in an introductory chapter addressed to the boys of England, tells how the desire to see foreign countries awoke in him at the tender age of six years. His youth was, however, passed amid poverty and privations in Hungary, and his travels did not commence until his twenty-second year, so that if any of his youthful readers feel inclined to follow Vambéry's example they must have patience and not begin by running away to sea. Throughout Vambéry seems to have lived entirely on his wits; but by dint of courage and what one is tempted to call "cheek"—if lady readers will forgive the expression—he has managed to come unscathed through some very remarkable adventures, which he tells with the utmost naïveté, even when they are hardly creditable to himself. The book is thoroughly interesting, beautifully illustrated, and got up in Mr. Unwin's well-known style.

Kaffir Folk-lore. By Geo. McCall Theal. Second Edition. (London: Swan Sonnenschein, Le Bas, & Lowrey. 1886.)—Mr. Theal says, and says truly, in his preface to the curious volume of tales before us, that "it is now generally recognised that in order to obtain correct information concerning an uncivilised race, a knowledge of their folk-lore is necessary." In this respect Kaffir folklore, like that of all semi-savage races, is highly instructive, adding yet again to the mass of evidence as to the identity of the purely childish type of mind and its universality among uncivilised people over the entire surface of the habitable world. Naturally, every such collection of stories peculiar to races widely separated geographically must possess a certain amount of local peculiarity and colouring; but, after making due allowance for this, the ultimate resemblance between the primitive stories of the most diverse types of mankind cannot fail to strike the least careful observer. Birds play a conspicuous part in these Kaffir tales, generally in the *rôle* of friends or good fairies to those in difficulty or distress. The giant or ogre of our European nursery tales finds his analogue in Kaffirland in the cannibal, whose intellectual capacity, we may incidentally note, appears to be quite on a par with that of the monster who fatuously slit himself up in attempted imitation of his guest in our own veracious legend of "Jack the Giant-killer." In "The Story of Hlakanyana," again, we have a sequent iteration of his adventures by the hero, resembling in form, if not in detail, that in "The House that Jack Built;" while the hare, the jackal, and many of their friends suggest the strongest reminiscences of the imperishable "B'rer Rabbit" and his associates in "Uncle Remus." A useful introductory chapter on the Kaffir folk themselves, and a full appendix of instructive notes on the various tales, add considerably to the value of this curious and readable volume.

The Elements of Economics. By Henry Dunning Macleod, M.A. Vol. II. Part I. (London: Longmans, Green, & Co., 1886.)—We make acquaintance with the work whose title heads this notice through its second volume, not having, so far, had the good fortune to see the first. It is not, however, very difficult to deduce Mr. Macleod's eclectic system of political economy from this second instalment of his work; and we feel quite justified in saying that if (as we may assume to be certain) the previous portion of the book before us is as sound in its inferences and apposite in its illustrations as the one before us, it as a whole constitutes a valuable and important contribution to economical science. The volume opens with an amusing refutation of

the fallacies of Ricardo in connection with the quantity of labour and the cost of production, and, incidentally, Mill's self-contradiction does not escape criticism. The subject of profits is next discussed, as are in succession interest and discount. We then arrive at the *vexata quæstio* of rent, and here again our author makes mincemeat of Ricardo's teaching, and shows how, if landlords were swept off the face of the earth, the consumer would derive no benefit whatever. The chapter on labour, which follows the one on rent, is eminently well worth reading, demolishing as it does certain stock dicta of political economists which have come to be regarded almost in the light of fetishes; or, at any rate, as being inexpugnably true and quite unassailable. The eleventh chapter deals with rights or incorporeal wealth, and the work is brought to a conclusion by a series of successive dissertations on foreign exchanges, Law's theory of paper money, the definition of currency, and the organisation of the Bank of England. On the practical value of this portion of the volume to the banker, merchant, and financier it is quite needless to insist; while the less special parts of it will commend themselves by their soundness, accuracy, and, in short, plain commonsense, to every student of the science of economics.

School Electricity. By J. E. H. Gordon, B.A. Camb. (London: Sampson Low, Marston, Searle, & Rivington. 1886.)—Mr. Gordon modestly calls this capital book "School Electricity," but the adult who will take the pains to master its contents will have derived no mean knowledge of the science. For it certainly enters into more varied detail of an elementary kind than any similar book which has, up to the present time, fallen under our notice, and supplies just that kind and amount of information needed for the intelligent apprehension of the principles of electrical measurement, and the practical application of electricity in the telephone, the electric bell, electric lighting, the dynamo, electrolysis, the induction coil, &c., to say nothing of its more recondite affinities with other forms of force. Our author commences with a description of the nature and most salient effects of the electric current, and in the outset explains Ohm's law. The question of the speed of the current through wires and telegraph cables naturally leads to the subject of magnets and electro-magnets, to lines of force, and the application of the magnet to telegraphy. Then a chapter on the relation of electric currents and pressure to mechanical forces is followed by a highly practical one on electrical units. After this the sources of electricity are discussed, as are in succession electro-measurements, telegraphy, the telephone, electric bells, electric lighting, and electrolysis. From these more especially economical applications of electricity we pass to diamagnetism and magnecrystallic action, the induction coil, and Crookes's marvellous researches on radiant matter, the volume concluding with chapters on the action of magnetism and electricity on polarised light, and on Clerk Maxwell's electro-magnetic theory of light itself. A series of examination papers forms a kind of appendix (in addition to questions which appear at the end of each chapter), and an index completes the work. We can heartily recommend Mr. Gordon's volume to all students of electricity.

The Laws of Nature and the Laws of God: A Reply to Professor Drummond. By Samuel Cockburn, M.D., L.R.C.S.E. (London: Swan Sonnenschein, Le Bas, & Lowrey. 1886.)—That a gigantic *petitio principii* underlies the whole of the arguments in Professor Drummond's very able and remarkable book, he would himself probably be scarcely concerned to deny. Admitting, however, his postulate, no one can fail to admire the conspicuous ability, moderation, scholarship, and eloquence with which he advances and enforces his thesis, and hence anything claiming to be a "reply" to his contention must, to be in the least degree effective, meet him on his own ground. This Dr. Cockburn fails, hopelessly, to do in the mass of twaddle now before us. His argument, if it can be dignified by that name, is founded on the familiar type of polemics to be heard in street discussions. "I say it is." "I say it is isn't," and so on *da capo.* Two quoted specimens of his science and theology respectively will suffice to exhibit his argumentative and ratiocinative power. The first develops a new theory of genesis, and is to be found on pp. 18 and 19. "The forms of matter are often determined by conditions under the control of man, and thus, in so far as the forms are concerned, he becomes a creator in the sense of a potter. . . . There are noxious and destructive forms of matter which in a paradisaical condition could have had no existence, *and which never were created by God*, and which in a truly regenerated condition could be of no use, and consequently could not exist. We need only mention in this connection all the family of parasites and the widespread, destructive germs of disease." If this sentence (and notably the words we have italicised) means anything, which is, of course, open to discussion, it can only be interpreted as signifying that, while the sunshine, the rose, and the lamb were the subjects of Divine creation; the louse, the flea, and the stomachache are the products of man's perverted pottering with protoplasm. Our theological quotation shall be shorter still. On page 35 we read:—"The man spiritually dead is not what God made him, and *not what God intended him to be*" (the italics are again ours). Whether Dr. Cockburn here denies the omnipotence or the omniscience of his Deity, he does not condescend to inform us. If Professor Drummond had been seeking an easy triumph, we can well imagine him repeating the concluding clause of the 35th verse of Job xxxi. in connection with a farrago which we close with a sigh of relief.

Gossip.

By Richard A. Proctor.

In reply to many questions, I note that the translation of Josephus, from which I quoted in "A Historical Puzzle," and last month, is Whiston's well-known one. So far as I know, there is only one edition of that translation published, and a singularly cheap one it is.

* * *

Many correspondents have been careful to point out that several theologians have accepted, as genuine, the passage in which Josephus is made to refer to Christ as being the Messiah. Of course, that is well known. Whiston himself accepts the passage. Even Renan does. But Renan, like the theologians, held a retainer for that side. The theologians who reject it are more to the purpose.

* * *

The evidence would satisfy any one who had not been trained to see everything of one colour till his natural eyesight was of no use to him. After Photius had tried to explain why there was no reference to John the Baptist, we find a passage relating to John the Baptist which Photius must either not have known, or must have rejected. After Origen had dwelt on the absence of all reference to Christ, we find a passage relating to Christ as veritably in Josephus's opinion the Messiah. And it is not noticed by theologians of the "find-anything-in-anything" school censured by Bishop Butler, that not only do the two passages stare out as interpolations, even as patches of yellow in a purple garment,

but they make the silence of Josephus elsewhere more stupendously amazing.

* * *

The "deliberate dishonesty" theory one can understand: though it may outrage probability, it stands at any rate four-square. But this, the only conceivable explanation of Josephus's silence about events said to have happened in the very time about which he inquired most diligently, in the city where his father and family had lived in high repute and consideration, and to whose archives and records he had freest access, is simply knocked on the head if we accept as genuine the passages to which I have referred as manifestly and admittedly interpolations. That a man capable of dishonest silence throughout all the rest of his voluminous works (about events said to have happened with such surprising circumstances that every one, poor and rich, was moved by them) should have written, nevertheless, a paragraph stating that the Messiah expected by the Jews at that very time had actually appeared and wrought many marvellous works, is simply what no one not lunatic, as De Quincey puts it, can suppose when he thinks of it. A through-thick-and-thin theologian, of course, has nothing to do with thinking about such things, and may consistently refrain; but a sound theologian acts more wisely.

* * *

If we found a long account of a summer day's jaunt round Hougoumont and Waterloo on June 18, 1815, without any reference to such a trifle as a battle thereabouts, we might understand that there was a mistake somewhere; but if some one pointed out a passage before unnoticed, stating that, "as we were sitting down to lunch, we observed that a battle was in progress half a mile off during which many surprising episodes occurred; the lunch also was excellent, and when it was over we sauntered past Hougoumont, collecting many pretty flowers by the way;" and so on, we should hardly find in that passing reference to the Battle of Waterloo an explanation of the difficulty. Even a half-crazed historian would hardly quote that letter as throwing any light on the condition of the roads, or the weather, or the feelings of the peasantry, on the day when the Fight of Giants was fought out.

* * *

To any one who thinks for himself a little, the interpolated passage in Josephus in which the coming of the Messiah, which would be to a Jew the most important and enthralling of all possible events, is thrown in casually as a mere detail in the midst of a history whose whole colour would have been altered if Josephus had had any inkling of such an event, must seem as inconceivably out of place as a mere passing reference to the Battle of Waterloo in a letter supposed to describe events which took place on the field and on the day of that great conflict.

* * *

A deliberate determination to reject and deny what he did not want to accept and announce is the only conceivable explanation of Josephus's silence, if we take choice among any of the dates to which the diverse narratives in the Gospels necessarily point. Rejecting the interpolated passage is not raising but avoiding a difficulty. But if we accept that explanation, as Canon Farrar suggests that we should (it is not an explanation *I* have suggested), we can hardly escape the inference of further offence against honesty involved in the passages which I quoted. We want no confirmation from the author of "Supernatural Religion," from Mr. Solomon (whom I only mentioned because it was the reading of a part of his book which led me to read over Josephus again), from Mr. Matthew Arnold, or from any one else. *There* are the passages in Josephus's book. Let them be taken, if any will, as mere coincidences; they are then very curious of their kind, as is the mind (I fancy) which can so regard them. But I had nothing to do with making them.

* * *

Nor am I concerned by such objections as that Zechariah, the son of Baruch, and Zechariah, the son of Barachiah (in the Revised Old Testament we have Berechiah), cannot have been one and the same person. Josephus knew all about the prophet, and had probably as keen a recognition of the fact that the person slain in the temple was not the prophet as has any theologian of the present time. [Whether a Jew unlearned enough to mistake the Hebrew way of saying the same thing more than once as saying two different things, and so inventing diverse fulfilments of the same prophecy (as in supplying not only an ass, but "also and moreover" a colt, the foal of an ass, and in not only dividing a vesture, but having lots cast for a garment), would be equally sure about the distinction, is a matter not so clear, and not being at present a student of theology, I desire to express no opinion on that point.] But I was picturing Josephus in the fancy character of a plagiarist, and my argument has nothing whatever to do with the question whether Baruch and Barachiah, or Berechiah, can be the same person. Josephus as a plagiarist would probably make them different persons. Regarding him merely as a historian, which is after all the safer plan, all we know for certain is that, according to his account, one Zechariah, son of Baruch, was killed within the temple, to the great horror of the Jews, some forty years after the time when Matthew speaks of a reference to the similar and similarly startling murder of one Zechariah, son of Barachiah.

* * *

M. Pachmann's sudden loss of music-memory when, unfortunately, he was taking part in a concerted piece (so that he could not pass over the gap by original composition) has been much commented upon. He has been seriously blamed for trusting, under such circumstances, to memory. But it may well be questioned whether the superior effects obtained when a player trusts to memory rather than to book are not cheaply purchased at the risk of occasional failure. A player must either follow the book *seriatim* or not at all. He cannot, as some of the musical critics seriously advised, have the book before him to put him right at any moment. If Pachmann had the music before him, and was moved, after playing a page or two, to throw all his fire into his fingers, leaving the printed notes alone, he would fail just as completely, if memory deserted him for a moment, with the book before him, even though it were open at the right place and he knew the precise spot where the slip occurred, as though he had no book at all. Now, there can be no doubt whatever that Pachmann playing a piece through from the book, would be a different performer altogether from Pachmann luxuriating in the rendering of the same piece from memory. The very fact that he plays in public constantly from memory unfits him from playing before the public from book. It was the same with Ketten. He said to me on this very subject (I had touched on the risk of a sudden slip of memory), "I shall play from book and I shall play from memory; but when I play from memory I am Henri Ketten, when I play in public from book I shall be some one else."

* * *

Memory in such matters plays curious tricks. Dickens found that those passages which he had recited oftenest were precisely those which he could least trust himself to recite

without book. If he went wrong through some momentary slip, he was wrong altogether. There were no side-holds for the memory to grasp at.

* * *

My own experience has been similar. In my lectures I frequently find it convenient to recite passages from memory. Some of these I have recited so often that I hold them entirely by what may be called syllabic memory. Now I know that I must either entirely relearn these passages or else in reciting them I must trust solely to the syllabic succession of sounds. If I were to begin to think about the succession of ideas I should be very apt to get off the syllabic track, and then I should be hopelessly lost. But one may get off the syllabic track even when avoiding the distraction of thinking about the succession of ideas. The accidental misplacement of a word, or even of a gesture, will throw the memory out. (I should not wonder if Pachmann's trouble arose from a slight change of fingering in a piece which he knew rather too well.)

* * *

A singular accident of this sort occurred to me once when I was closing a lecture at Columbia, South Carolina. I used for *finale* certain lines in Anstey's translation of "Faust," which I suppose I must have repeated a thousand times. They begin—

> See all things with each other blending,
> Each to all its being lending,
> Each on all in turn depending.

Now, unconsciously I have fallen into the habit, when reciting this passage, of using gestures in some degree corresponding with the ideas suggested by each line. I bring my hands towards each other, with open fingers, towards the close of the first line, as if blending together objects (indefinite in nature) in front of me; I throw out my hands, fingers closed, in the second line, as if lending; I move my hands downwards, as if setting objects in dependence on other objects, as I repeat the third line; and so on to the end. But I had never noticed how these gestures had become associated with the action of the memory when I was reciting this effective *finale*, till, on the occasion I refer to, the fact was brought to my notice in a rather unpleasant way. Not using the customary gestures in the first two lines, I went wrong syllabically in the second, saying "each *on*," instead of "each *to*." It will hardly be believed that so slight a fault brought me utterly to grief. After vainly trying to pick up the third and fourth lines, I tried back from the beginning, but again I failed, this time at about the fifth line. A third time I tried, and so far as those of the audience were concerned who did not know the lines, I seemed to get through all right. But in reality I failed as egregiously in the matter of memory that third time as the other two; only, having determined to get through somehow, I eked out memory with invention, and, composing five or six lines of my own, brought the quotation (save the mark!) to a close. I was rather tickled when some one told me afterwards that he was glad I had been able, after all, to recall those fine lines. (I cannot recall my own lines, but I have a notion they were rather fine nonsense.) I had not had so unpleasant an experience since I first learnt what a wide difference there is between knowing a passage by heart for recital to yourself and knowing it for recital before a crowded audience.

* * *

Mr. Labouchere, who wants to reform the hereditary House, is also evil-minded enough to object to the fine old manner of walking backwards before hereditary rulers. He would thus destroy an effective illustration of hereditary humbug. But stay; reading on, I find he is not so wildly, so madly revolutionary after all. He proposes only a change. He suggests that it would do if, instead of walking backwards at the risk of tumbling, the abject ones tumbled in the first instance, and allowed royalty to honour them by trampling a little upon their prostrate bodies, or giving them an appropriate kick or two. I fear he is not in real earnest. Nothing is sacred to some men. It is saddening.

* * *

The discussion raised in the *Guardian* by Prof. Pritchard's remarkable change of face in regard to the cosmogonies combined in the opening chapters of Genesis is interesting, and in some degree amusing: all the writers are so singularly clear that they are discussing what was literally God's Word, and so singularly blind to the fact that their differences of opinion as to its meaning amounts to very unfavourable criticism of the whole record! What would be thought if a dozen critics, knowing some passage to be by Milton or Shakespeare, were to agree in saying, It is magnificent, it is the grandest and most beautiful thing either poet ever wrote; but—we have not a clear idea as to what it actually means? We other folks, who recognise in the opening chapters of Genesis a very interesting relic of ancient science, edited after the Babylonian exile, and ingeniously combining with an old account ideas belonging to much later times, are surely much more respectful—not to say less blasphemous—than those who picture Deity as either not knowing much about His own work, or else as writing (whether designedly or otherwise) so as to confuse counsel. The theologians, at any rate, *are* confused. For though when they work together their unanimity is wonderful, the case is very different when they work apart. Under such conditions they somewhat resemble Susanna's elders.

* * *

They agree tolerably in rejecting Professor Pritchard's "sleeping seer," who is, indeed, only a mild version of Dean Stanley's "gifted seer." Professor Pritchard will allow no truth in the old story, only wonderful beauty. All other cosmogonies, he tells us, are dull and prosaic beside the first chapter in Genesis. This reminds me of a speech made after a lecture I had given about the Star-depths. The reverend chairman said, somewhat at length, that what the audience had heard about the glories of the star-strewn universe, the millions of millions of suns, each pouring forth such amazing supplies of light and heat, and with them life to circling worlds—all this, and infinitely more, had been already expressed in words which were the most beautiful, the most awe-inspiring, the most impressive of all that had ever been uttered by man about the heavenly bodies,—those glorious and noble words—(the audience waited in mute expectancy) —"He made the stars also." For, setting aside all thought of scientific accuracy, all question of inspiration, it must assuredly be admitted that four-fifths of the chapter which seems so poetical and beautiful to Professor Pritchard is mere cataloguing. He might as reasonably tell us to be moved to emotion by that noble verse, that most impressive passage—"Eber, Peleg, Reu." We need not deny the genealogical value of the list of the descendants from Shem; some may even consider that an ancient Hebrew was moved by divine inspiration to record them; but to find poetical beauty or noble imagery in "Eber, Peleg, Reu" is to "offer to the Almighty the unclean sacrifice of a lie." It is bad enough to offer bad science and unsatisfactory literature to God as His own; but one may do worse even than that.

* * *

The Secretary of the Victoria Institute has singularly misapprehended my remarks about the reading of Mr. Boscawen's paper. I really fail to understand how anyone

could imagine me to be in earnest in rebuking the society for their evil ways in encouraging the spread of truth. Of course I think the society altogether right. What tickled me, and still tickles me immensely, was the absurdity of the comments made by one or two strangely-minded persons about a paper which is as entirely inconsistent with the Bible genealogy of the Semite race as it could well be. I am always very much amused by examples of the Rogue Riderhood style of glorification—the *Now*-say-I'm-a-liar tone —which feeble-minded persons display when such ancient records as the Cuneiform cosmogony, the account of Izdubar, and the like, or tablets relating to events which happened of old in Palestine, are brought to light. Something in the Hebrew record corresponds with something in the ancient record on rock or clay, relating no doubt to the same events, and immediately most of the half-educated among the clergy (and, alas! they are many) proclaim their joy in a tone implying a most unreverent astonishment; as if they went about in constant fear lest records should appear proving the Bible history (probably accurate in most of its details) to be false and misleading. I know none who so gravely insult and oppugn the Bible records as these loudest-voiced and least cultured of the clerical community. It is refreshing to turn from such weaknesses to the writings of men like Arnold, Stanley, Temple, and Abbott.

* * *

It has been arranged that I should deliver two more discourses at South Place Chapel, Finsbury Circus—viz., Sunday, April 4, on "The Bible and Science;" Sunday, April 11, on "The Bible and Duty." The hour on each occasion is 11.15 A.M.; admission free.

* * *

I am pleased to see that the London Stereoscopic Company, Limited, will hold their second annual International Amateur Photographic Exhibition at Archibald Ramsden's Pianoforte Galleries, 103 New Bond Street, from April 15 to May 24 current, under the patronage of the Princess Frederica, the profits to be given to the Princess's Convalescent Home at Hampton Court. Photography has, of late years, advanced by rapid strides, and, besides affording almost unlimited pleasure and instruction to amateurs who pursue it, it has proved a veritable boon in many ways to the science student. I hope the exhibition may prove an unqualified success.

* * *

A friend points out that a number of the expressions under the head "Americanisms" are English too. I know it. But they are properly called Americanisms all the same, in being much more widely and generally used in America than in the old country. For instance, everyone knows that Bundling, regarded as a custom, has prevailed in Wales for hundreds of years, and it is said still to exist in certain English-speaking counties, where doubtless the word also existed long before it came to be used in New England. Yet the word "bundle" so used is undoubtedly an Americanism.

* * *

So "of no account" is English, yet to speak of "a no-account man" is an Americanism, and indicates the more general use even of the original expression in America. "Bang-up" appears in Pierce Egan's elegant writings, but in America is probably older than George IV.'s time, and is now certainly more common there than here. "Beat," used as in the sentence "that beats everything," is as widely English as any expression can well be; and I fancy Mr. John Brown used the expression, "Did anyone ever see the beat of that?" on some occasion described in a certain awe-inspiring diary. Yet the multiplied forms of the use of "beat" as noun and verb must be regarded as characteristic of American talk. "I am bound to win" is as English as "I am bound to admit," yet no one who has noticed the multitudinous ways in which the word "bound" is used in America can doubt its having achieved the position of an Americanism.

THE FACE OF THE SKY FOR APRIL.

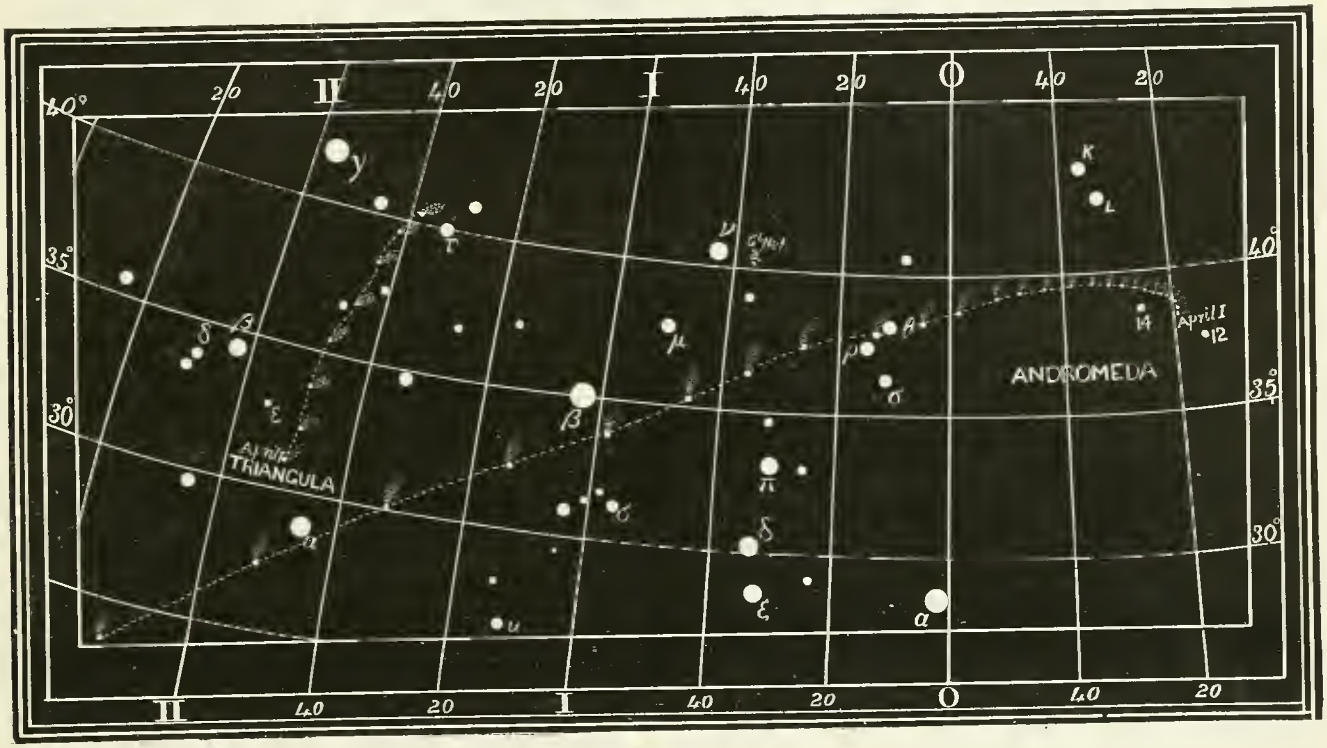
By F.R.A.S.

[In resuming (in accordance with the Editorial announcement on page 164) this series of descriptive notices of the aspect of the sky during the successive months of the year, we would point out that for their profitable use and apprehension the student should provide himself with the volume of maps entitled "The Stars in their Seasons," by the Conductor of Knowledge, and should also carefully read the papers on "The Phenomena of Jupiter's Satellites," and on "Lunar Occultations," on pages 126 and 267 respectively of our fifth volume. With which preliminary advice we proceed to the immediate subject of our Notes.]

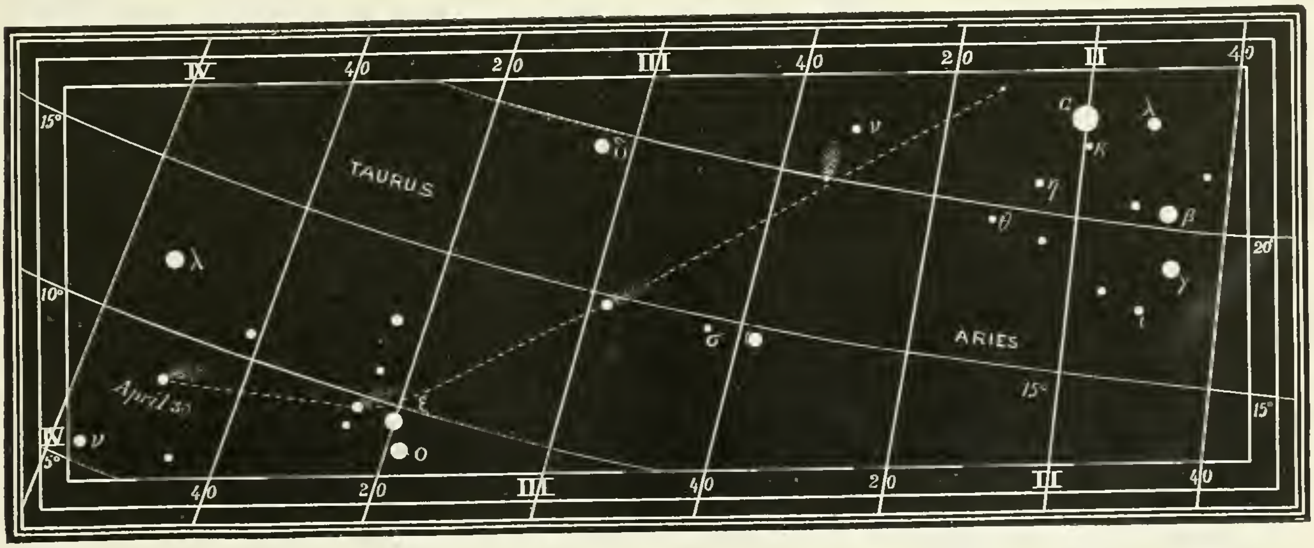
THE sun should be examined on every clear day for spots and faculæ. The period of maximum being now definitely past, no such splendid individual spots and groups as appeared in 1884–85 are now visible; but still at less frequent intervals very fine and striking indications of disturbance appear on the sun's disc. At the beginning of the month the zodiacal light may still be seen in the west after sunset. The night sky is depicted in map iv. of "The Stars in their Seasons." Minima of the remarkable variable star Algol in Perseus ("The Stars in their Seasons," map xii.) will occur on April 10, at 2h. 49m. A.M.; on April 12, 11h. 38m. P.M.; and on April 15, at 8h. 27m. P.M. For all practical purposes Mercury will be invisible during April, as he comes into inferior conjunction with the sun, or, in other words, between the sun and the earth, at four o'clock in the early morning of the 9th. Venus may be seen glittering brilliantly to the south of east before sunrise. In the telescope she exhibits a beautiful crescent just now. Mars is visible through the entire working night of the ordinary amateur, and will be seen as a fiery-red star to the east and north of ρ Leonis ("The Stars in their Seasons," map iv.) The dark markings or "seas" and the Polar snow are still fairly observable even in a three-inch telescope, but the angular diameter of the planet diminishes towards the latter part of April. He is now slightly gibbous—*i.e.*, not quite round. Jupiter is a noble object in any telescope. He will be found between β and η Virginis ("The Stars in their Seasons," map iv.) His angular equatorial diameter is 41·2″ on April 1, but by the 30th it has diminished to 39·4″. The phenomena of his satellites visible before 1 A.M. are numerous and interesting. Beginning with to-night: a transit of Satellite I. will commence at 11h. 9m., followed by that of its shadow at 11h. 24m. On the 2nd, Satellite I. will be occulted at 8h. 20m. P.M., as will Satellite II. at 9h. 23m. Then at 10h. 50m. 50s. Satellite I. will reappear from eclipse, Satellite II. similarly reappearing 42m. 47s. after midnight. On the 3rd, Satellite I. will pass off Jupiter's face at 7h. 50m. P.M., as will its shadow at 8h. 9m. On the 4th, the shadow of Satellite III. will enter on to the planet's face at 7h. 50m. P.M., and the satellite casting it leave his opposite limb at 9h. 21m., its shadow not quitting the disc of Jupiter until 10h. 47m. All transits of the two outer satellites should be sedulously watched, as they, practically invariably, cross Jupiter's face as *dark* spots, besides presenting other curious phenomena. On the 5th the shadow of Satellite IV. will enter on his limb at 11h. 49m. P.M. On the 8th Satellite I. will begin its transit 54 minutes after midnight. On the 9th the same satellite will be occulted at 10h 5m. P.M., as will Satellite II. at 11h. 39m. Then at 12h. 44m. 46s., Satellite I. will reappear from eclipse. On the 10th the ingress of the shadow of Satellite I., the egress of the satellite casting it, and the subsequent egress of the shadow will follow each other in succession at 7h. 48m., 9h. 35m., and 10h. 4m. P.M. respectively. On the 11th, Satellite II. will pass off the planet's limb at 8h. 48m. P.M., as will its shadow at 9h. 49m. Then Satellite III. will begin its transit at 9h. 51m., followed by its shadow at 11h. 49m. The Satellite will leave Jupiter's opposite limb at 12h. 41m. P.M., the

shadow not until the next morning. On the 16th, Satellite I. will be occulted at 11h. 49m. On the 17th the ingress of Satellite I. will happen at 9h. 5m. P.M., and that of its shadow at 9h. 43m. The Satellite will leave the face of the planet at 11h. 21m.; the shadow at 11h. 58m. P.M. On the 18th the transit of Satellite II. will begin at 8h. 18m. P.M., and then Satellite I. will reappear from eclipse at 9h. 7m. 21s. Later, the shadow of Satellite II. will enter on to the planet at 9h. 36m. The satellite will quit the opposite limb at 11h. 4m., and its shadow follow it 23m. after midnight. On the 22nd Satellite III. will reappear from eclipse at 8h. 43m. 44s. P.M. On the 24th the ingress of Satellite I. will occur at 10h. 52m. P.M., and that of its shadow at 11h. 37m. On the 25th the transit of Satellite II. commences at 10h. 35m. P.M. Satellite I. will reappear from eclipse at 11h. 10m. 34s., and the shadow of Satellite II. follow the satellite itself on to the planet's face at 12h. 10m. On the 26th the shadow of Satellite I. will pass off at 8h. 22m. P.M. On the 27th Satellite II. will reappear from eclipse at 9h. 52m. On the 29th, Satellite III. will reappear from occultation at 9h. 23m. P.M.; Satellite III. disappear in eclipse at 9h. 59m.; to reappear from eclipse at 12h. 41m. 19s. P.M. Finally, on the 30th, Satellite IV. will be occulted at 8h. 33m. P.M. reappearing from occultation at 10h. 1m.

Saturn, not far from η Geminorum ("The Stars in their Seasons," map ii.), may be seen in the western sky after it gets dark; but he is now very indifferently placed for the observer, and Uranus may be detected on a moonless night with the naked eye, as a very small star to the south and east of η Virginis ("The Stars in their Seasons," map v.). His occultation by the moon on the 16th will be spoken of below. The moon is new at 2h. 30m. 6s. P.M. on the 4th, enters her first quarter at 8h. 44m. P.M. on the 11th, is full at 2h. 59m. 2s. P.M. on the 18th, and enters her last quarter at 5h. 15m. 5s. A.M. on the 26th. She will occult seven stars besides the planet Uranus at convenient hours for observation during April. The first occultation is one to which particular attention should be paid. It is that of Aldebaran during the afternoon of the 8th, when the star will disappear at the dark limb of the moon at 5h. 8m.



Map 1.



Map 2.

at an angle of 175° from her vertex, and reappear at her bright limb at 5h. 54m. at an angle from her vertex of 257°. On the 9th the 6th mag. star 130 Tauri will disappear at the dark limb at 11h. 49m. P.M. at a vertical angle of 175°. The moon will have set before it reappears. On the 10th, 20 Geminorum, a star of the $5\frac{1}{2}$th mag. will disappear at the dark limb at 10h. 25m. P.M. at an angle of 143° from the moon's vertex, and reappear at her bright limb at 11h. 18m. P.M. at a vertical angle of 285°. On the 14th, 48 Leonis, a 6th mag. star, will disappear at the dark limb at 10h. 57m. P.M. at a vertical angle of 40°, reappearing at the bright limb at 11h. 40m. at an angle of 329° from the vertex of the moon. On the 15th, τ Leonis of the 5th mag. will disappear at 9h. 21m. P.M. at her dark limb at an angle from her vertex of 359°, to reappear at the bright limb at 9h. 55m. P.M. at a vertical angle of 310°. On the 16th, 13 Virginis, a 6th mag. star, will disappear at the dark limb at 6h. 14m. P.M. at a vertical angle of 69°, and reappear at the bright limb at 7h. 4m. P.M. at an angle of 180° from the vertex of the moon. Later on, at 9h. 58m. the dark limb of the moon will occult Uranus, who will disappear at an angle of 6° from the lunar vertex. He will reappear at her bright limb at 10h. 44m. P.M. at a vertical angle of 297°. Lastly, on the 18th, κ Virginis, a star of the $4\frac{1}{2}$th mag., will disappear at the moon's bright limb at 9h. 5m. P.M. at a vertical angle of 349°, reappearing at her opposite one (it will really be dark, but uncommonly close to the illuminated part) at 9h. 48m. P.M., at an angle from her vertex of 273°. At noon to-day, when our notes begin, the moon is in the confines of Cetus and Pisces. At midnight on the 2nd she crosses from Pisces into the narrow strip of Cetus running between that constellation and Aries, passing about 2h. P.M. on the 3rd definitely into the latter constellation. Crossing Aries at 5h. P.M. on the 4th, she enters Taurus, through which she is travelling until 7h. A.M. on the 7th, at which hour she quits it for the narrow northern portion of Orion. Her passage over this occupies her until 6h. o'clock in the afternoon of the same day, when she emerges in Gemini. Her passage through Gemini occupies her until 9h. A.M. on the 9th, when she enters Cancer. She has crossed this by 9h. P.M. on the 10th, and entered Leo. She travels through Leo until 10h. A.M. on the 13th, at which hour she quits it for Virgo. In Virgo she remains until 11h. A.M. on the 16th, when she enters Libra. She is travelling through Libra until 7h. A.M. on the 18th, entering at that hour the narrow northern strip of Scorpio. She takes 10 hours, or until 5h. P.M., to cross this, and then emerges in Ophiuchus. At noon on the 20th she leaves Ophiuchus for Sagittarius, which she quits in turn for Capricornus at midnight on the 22nd. She travels through Capricornus until 3h. A.M. on the 25th, when she enters Aquarius. Her journey through Aquarius is completed by 4h. 30m. A.M. on the 27th, at which hour she crosses into Pisces. Her passage through this great constellation occupies until 8h. A.M. on the 30th, when she once more travels into the narrow corner of Cetus, where we found her at midnight on the 2nd. There we leave her.

COMETS FABRY AND BARNARD.

Our notes above have reference, of course, to those familiar objects which are the invariable occupants of our day and night sky. During the present month, however, interest will largely centre in the two interesting comets which are nightly becoming more conspicuous over the north-western part of the horizon. The first was discovered in Paris by M. Fabry, on December 1, 1885, and the second by Mr. Barnard, at Nashville, in the United States, two days later. Our first map shows a portion of the path of M. Fabry's comet, which commences at a point a little to the north of a line joining the two small stars 12 and 14 Andromedæ. Thence it ascends slightly, passing below ι and κ in that constellation. On the 17th it will be pretty close to θ Andromedæ, and on the next night between θ and ρ. On the 22nd it will be a little to the south and west of β Andromedæ. Crossing, then, the extreme north-east corner of Pisces, it will be found in the confines of Triangula and Aries on the 25th, and on the 26th to the north-east of α Arietis. Map II. shows its course during the remainder of April. From it will be gathered that the comet on the 27th will be south-east of ν Arietis; on the 28th south by west of δ Arietis; on the 29th to the east of ξ Tauri, and on the last day of April to the south and slightly to the west of λ. It will rapidly increase in brilliancy as the month advances, and the student will note how its arc in the sky increases nightly in length.

The path of Barnard's comet is depicted in the left-hand portion of Map I. Commencing to the north-east of α Trianguli, it runs up into Andromeda, terminating almost on a line joining γ and τ Andromedæ, but much nearer the smaller star. As in the case of Fabry's comet, this is brightening very perceptibly. Unlike that object, however, which is at its brightest on April 29, Barnard's will not attain its greatest brilliancy until two or three months later. On the night of the 24th the comets will be a little more than 9° apart.

Our Whist Column.

ON THE ORIGINAL LEAD.

By Mogul.

PART I.

To exhaust this subject so much would have to be said that I certainly would not touch on it were I not convinced that the rule, more or less absolutely laid down by some of the more modern writers, that when trumps are not opened the original lead ought invariably to be from the longest suit, is radically wrong; and, further, that the rule is neither the outcome of experience nor adopted by the finest players of the day.

In considering the point I shall refer only to the first lead of the first player in cases where he does not lead trumps, thus practically excluding all cases where the leader holds five or more trumps, or where the lead is affected by the state of the score (a point which a certain quasi-philosophical writer totally ignores). The reader had better, therefore, in all cases suppose the score to be love all.

A player in opening the hand has to be guided partly by probabilities or chances, but principally by the strength of his own hand. Common-sense will tell him that, with a strong hand, he has a right to play a strong game and risk a little for the chance of winning the game in the one hand: but it will also tell him that, with a weak hand, it would be folly to play a strong game, and that, therefore, he ought to risk as little as possible. With a medium hand he must, so far as he can, play in such a way as will fall in with a strong game if his partner be strong, and hardly risk anything if his partner be weak. In this way he will much more assuredly combine his hand with his partner's than by adopting any fixed rule. It is right, therefore, if he has a long, weak suit, say of five headed by the Ten, with average strength in trumps and strong cards in the other suits, to open the long suit; for, should his partner have two or three cards in that suit with an average strength in trumps, he will probably be able to bring it in, and this probability justifies the risk he incurs of sacrificing any good cards his partner may hold in the suit. And here let me digress. What do you mean, the reader will say, by a long *weak* suit? Is not such a suit numerically strong? My reply is that the expression "numerically strong" is misleading. There is no strength in numbers irrespective of quality. A suit of Ace, King, and Queen is strong of itself, but a suit of six headed by no higher card than a Ten is intrinsically weak; and although, if the holder or his partner holds overwhelming strength in trumps, two or three tricks may be made in it, the suit itself lacks every element of strength. There is no hope with such a suit of capturing a good card of the adversaries', nor even, except by extrinsic aid, of making a trick in it; and, further, it is a weakness in a hand as seriously diminishing the chances of holding a really strong suit. To say, as Proctor says, that a suit of Two, Three, Four, and Five contains an element of strength because of the possibility of the Five being the thirteenth card is, so it seems to me, very loose language. If the remote possibility of making a trick is to be regarded as an element of strength, there almost must be in the hand some other suit containing a more reliable element of strength, and the argument based on this supposed element of strength would fail.* But, picking up the thread of my remarks, he would not be justified in opening such a suit if he held but two small trumps and a suit which he could lead without risking loss to himself or partner, say Knave, Ten, and Two, or even Knave and Two. The Knave in the latter case, and the Knave or Ten in the first case, must fall in the first two rounds; and, by leading it at once, a player effects two desirable objects—he strengthens his partner's hand by forcing out the adversaries' good cards in that suit, and prevents his own good card being wasted by falling to a better one led by his partner.

It seems to me to be downright folly to adopt the long suit system in obedience to mere theory when there is no reasonable chance of establishing it. It is playing an offensive game with a weak hand, and is opposed to the most important of all canons of play, viz., that play must vary with the circumstances. No wonder, therefore, that Pole, who lays down an absolute rule of leading from the long suit, admits that the object aimed at more frequently fails than succeeds, but in extenuation he alleges that no disadvantage arises from the attempt if unsuccessful. This is really

* If those who contend that mere numbers constitute strength are right, then a hand consisting of two plain suits, one of seven headed by the Eight, and another of six headed by the Seven, is a very strong hand. But does the reader think so?

coming it strong, considering that the fourth player will every other time on an average take your partner's best card, and if your partner holds the ace, it will generally be played without killing a good card of the adversaries, and Pole calls this no disadvantage! Now Cavendish admits the danger of finding your partner very weak, or of sacrificing what strength he has, but argues that, although your chance of establishing a Five suit is slight, yet, by leading it, you avoid assisting your adversary in establishing his long suit. This argument is weighty, and infinitely better than Pole's, but yet I submit not strong enough to induce us to lead from a long weak suit of 5, without an honour, when we have stronger suits, such as a suit of 4 with 2 honours, or even when our other suits are weak, but one of them contains a strong card which we can lead without harm to ourselves, and with a very good chance of assisting our partner. Although I do not regard even Clay as infallible, he is as near to it as any whist writer is likely to be, and he says:—"A lead from a Queen or Knave and one small card is not objectionable, if you have a miserably weak hand, or one in which the lead from any of the other suits is manifestly disadvantageous," and again: "A lead from Queen Knave, and one small card or Knave Ten and one small card is not bad when you have no better suit." Whilst on the point of the advantage of leading strengthening cards, I would note that it has struck me that Cavendish's and Pole's advocacy of invariably leading from the longest suit is partly due to mistaken ideas of the effect of leading strengthening cards. Cavendish, in his first edition, when explaining the advantages of leading strengthening cards, added:—"No doubt you are twice as likely to *strengthen your adversaries*, but with a wretchedly weak hand this cannot be avoided," and Pole says:—"The effect of leading strengthening cards is to benefit the hand that is longest in the suit," and adds that as it is two to one that the longest hand is with one of the adversaries, the chances are that you favour the opponents' hands, so that, according to Pole, if I lead a Queen and my partner holds King Knave Ten and one other and either adversary the Ace and four others, my lead of the Queen has benefited the adversary, and not my partner. Cavendish has omitted this absurdity in his later editions, but is it not possible that the feeling which permitted him to say it still somewhat warps his judgment?

Further, if it be objectionable, as above argued, to lead from a weak suit of five, much worse is it to lead from a weak suit of four, for you equally incur the risk of sacrificing your partner's good cards without the possibility of remaining with two or three long cards of the suit, and with less chance of remaining with even one long one. For these reasons, holding Knave or Ten with one other, I should prefer (as I believe do nearly all our best players) to lead it rather than lead a small card from Knave or Ten with three small ones. One feels that the lead from the latter suit may sacrifice one's partner's King or Queen without any benefit to oneself or partner. The lead from King or Queen and three small ones is not so objectionable; but I certainly should myself always prefer leading Knave from Knave, Ten, and another, to opening a suit of King and three others, unless the highest of the three was a Knave, Ten, or Nine. The objection that the lead of the Knave may be mistaken for a lead from strength may be disregarded, for it will be but rarely that your partner will not be able, even on the first round, to infer whether your Knave is a strengthening card or not; and, if he cannot be sure, he will, if a good player, not jump to the conclusion that it is a lead from strength.

For the above reasons, I contend that an inflexible rule of leading from the longest suit cannot be a good one, and that the only excuse for leading from a long weak suit, when there is no hope of making long cards in it, is that to open any other would be equally disadvantageous to your partner, and probably more advantageous to your adversaries, and that this can never be said when you can lead a strengthening card from one or two others.

It will perhaps be contended that I am ignoring the advantage of the information given by a rigid adherence to the rule of opening the longest suit. I have, however, taken this into consideration. Even assuming that the balance of advantage of the information so given rests with yourself and partner, I think it very dearly purchased when the price paid is the sacrifice of your partner's good cards. Further, I find in actual play that the knowledge that an adversary has a number of small plain cards is one of the most useful data in judging whether to lead trumps or not; and I hold that to play badly merely to give information is, except in very rare instances, downright irrational, and to sacrifice the good cards of one partner, so that other partners may be assured that you have four at least in your original lead, is hardly fair to your partner for the time being; consequently I protest against the advice too often given to young players to play for some time by fixed rules, "in order to earn a character." What right has any one to play any hand otherwise than appears to him most beneficial, in order that he may get a benefit to himself at the expense of his partner? But, over and beyond this, I consider all attempts to tie the hands of whist-players and to put an end to individual judgment by rigid rules of play most objectionable in principle, and that no player who is admitted by his brother-players to be skilful above the average should submit to be so tied, at any rate not unless he knows that the person who wants to bind him is quite at the top of the tree; for, notwithstanding Pole's assertion that the dicta of Clay owe their chief value to the fact that they admit of being demonstrated by philosophical reasoning, I have more respect for the dicta of Clay and other fine players, as pure dicta, than I have for all the so-called philosophical, but in some cases downright illogical, reasons stated by Pole.

I propose in the next part to insert some hands submitted to a number of our best players for their opinions on the original lead and to state the results.*

HANDS ARRANGED BY "MOGUL."

Hands.	Trumps, Spades	Clubs.	Hearts.	Diamonds.
No. 1	Kg., 8	10, 9, 7, 6, 4, 2	A., Kg., Q.	Kn., 10
,, 2	9, 8	9, 8, 7, 6, 3	A., Kg , Q.	A., Kg., Q.
,, 3	5, 3, 2	10, 9, 8, 7, 6	A., Kg., Q., Kn.	Kg.
,, 4	5. 4, 3, 2	5, 4, 3, 2	A , Kg., Q.	A., Kn.
,, 5	Q., 4, 3	Kg., 6, 5, 2	Q., 7, 6, 3	Q., Kn.
,, 6	Q., 10, 9	6, 5, 4, 3, 2	Q., Kn., 10	Kn., 10
,, 7	Q., 10, 9	Kn., 8, 7, 4	10, 8, 6, 4	Kn., 9
,, 8	Kg., 6, 2	Kn., 6, 5, 4	Q. Kn., 10	Kn., 10, 9
,, 9	9, 8, 5, 4	Q., Kn., 8	Kn , 10, 2	A., Kg., Q.
,, 10	A , Q., 10, 2	Kg., Kn., 3, 2	Kg., Q , Kn.	10, 9

What card should first player lead from above hands—first, when the score is love all; and secondly, when the score is four love?

These hands are not intended to be difficult, but solely to test how far players of admitted skill feel themselves bound to lead from their longest suit, rather than exercise their individual judgment as to the best card to lead from each hand as it arises. They are therefore asked, What card they would themselves lead? not which one they would advise a beginner to lead.

Our Chess Column.

By "Mephisto."

The following is the eleventh game of the match for the championship, played at New Orleans on March 1:—

Four Knights Game.

White. Zukertort.	Black. Steinitz.	White. Zukertort.	Black. Steinitz.
1. P to K4	P to K4	17. B × P (ch) (*f*)	K × B
2. Kt to KB3	Kt to QB3	18. Q to R5 (ch)	K to Kt sq
3. Kt to B3	Kt to B3	19. R to R3	P to B3
4. B to Kt5	B to Kt5	20. Q to R7 (ch)	K to B2
5. Castles	Castles	21. Q to R5 (ch)	K to B sq
6. Kt to Q5	Kt × Kt	22. Q to R8 (ch)	K to B2
7. P × Kt	P to K5 (*a*)	23. Q to R5 (ch)	K to K2 (*g*)
8. P × Kt	P × Kt	24. R to K3 (ch)	K to B sq
9. Q × P	QP × P	25. Q to R8 (ch)	B to B sq
10. B to Q3 (*b*)	B to Q3	26. B to R6	R to K2 (*h*)
11. P to QKt3	Q to Kt4 (*c*)	27. R × R	K × R
12. B to Kt2	Q × QP (*d*)	28. B × P	Q to KB4!
13. B to B sq (*e*)	Q to QR4	29. R to K sq (ch)	K to B2!
14. B to KB4	B to K3	30. B to R6	Q to R2
15. QR to K sq	KR to K sq	31. Q × Q	B × Q
16. R to K3	B to Q4	32. P to QB4	P to R4

White resigned on his forty-second move.

NOTES.

(*a*) Leading to an even game. Played by Gunsberg against Ranken in the 83 Tournament.

(*b*) This points to an attack on the K's side, the prospects of which cannot be considered favourable. White might have played 10B to B4.

(*c*) An excellent move, which gives Black the advantage—he threatens Q to K4, also to bring his QB into play.

(*d*) Steinitz himself adopted somewhat similar tactics in his sixth game. It seems that in the present instance this QP can be taken.

* These hands I venture to publish here, as it will, I think, add greatly to the readers' interest in "Mogul's" second paper to have had the opportunity of studying the hands first by himself.—Ed.

(*c*) In order to prevent the exchange of Queens by Black playing Q to B5.

(*f*) White, we think, would not have given up this piece if he had not been minus a Pawn. The attack, though considerable, does not promise a win. It does, however, seem as if a draw by perpetual check always remained available. That this was not the case is due to Black's correct play and capital defence. White would gain nothing by playing 17Q to R3, P to KKt3, &c.

(*g*) In order to gain time, Black four times played his K to B sq and B2 before playing K to K2.

(*h*) If P × B White draws by perpetual check.

Black.

White.

The following was played in the late Tournament at the British Chess Club. It contains a noteworthy variation of the French defence:—

White I. Gunsberg	Black J. Mason	White I. Gunsberg	Black J. Mason
1. P to K4	P to K3	12. Kt to K5 !	P to B3
2. P to Q4	P to Q4	13. Castles (*g*)	P to KR4
3. Kt to QB3	B to Kt5 (*a*)	14. Kt (K5) to B7	R to R2
4. B to Q3 (*b*)	P to QB4	15. Q to B3 ! (*h*)	Q to R4
5. P × BP (*c*)	P to Q5	16. P to K5	Q to B3 (*i*)
6. P to QR3	Q to R4 (*d*)	17. P × P	Q × Q (*j*)
7. P × B (*e*)	Q × R	18. P × Kt (ch)	K × P
8. Kt to Kt5	Kt to QR3	19. P × Q	B to Q2
9. Kt to Q6 (ch)	K to Bsq	20. B to Kt5 (ch)	K to B sq
10. B × Kt	P × B (*f*)	21. Kt to K5	B to K sq
11. Kt to B3	Kt to K2	22. R to Q sq	Resigns

NOTES.

(*a*) Many players do not like this move, and give preference to Kt to KB3, and keep the B on K2.

(*b*) 4. P × P is usually played here. In reply to 4. B to Q3, Black's best is P × P. 5. B × P, Kt to KB3, whereby he gains time for development.

(*c*) 5. P × QP is also admissible.

(*d*) This is bad, and leads to a lost game. If, instead B to R4, then 7. P to QKt4. P × Kt. 8. P × B, Q × P. 9. B to K3, Kt to Q2. 10. Kt to K2, with an even game.

(*e*) White obtains a piece and two Pawns, with a strong attack, for the Rook.

(*f*) Q × B is preferable.

(*g*) This move gives White an overwhelming attack. Black dare not take the Kt; he would speedily lose, as White could then play. 14. Q to B3 (ch), compelling Kt to B4, then 15. P × Kt would be fatal. White also threatens now to play Q to R5, against which move Black must be on his guard. Black's game, however, is hopelessly compromised now.

(*h*) Threatening 16. P to K5, also 16. B to Kt5, followed by 17. B × P and 18. Q × P, &c.

(*i*) If Kt to K4 instead then follows. 17 Kt to K Kt5, R to R sq. 18. Kt × B, R × Kt. 19. Kt × P (ch), K moves. 20. Q × Kt and wins.

Black.

White.

(*j*) If P × P instead, White continues with 18. Q × P.

An interesting variation in the Scotch defence:—1. P to K4, P to K4. 2. Kt to KB3, Kt to QB3. 3. P to Q4, P × P. 4. Kt. × P, Kt to B3. This is the German defence to the Scotch gambit, and should lead to an even game. Zukertort played it throughout in his match with Blackburn.

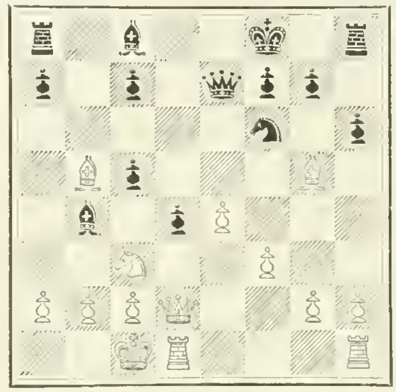
If now White plays 5. Kt × Kt, Kt P × Kt. 6. B to Q3, P to Q4. 7. P to K5, Kt. to Kt. 5. 8. Castles, B to QB4 (threatening Q to R5). 9. P to KR3, Kt × KP. 10. R to K sq, Q to B3. 11. Q to K2, Castles. 12. Q × Kt, Q × P (ch). 13. K to R sq, B × RP. 14. P × B, Q to B6 (ch). 15. K to R2, B to Q3 winning.

Another variation in which Black's development proceeds on the Q side is as follows:—5. Kt × Kt, Kt P × Kt. 6. P to K5, Q to K2. 7. Q to K2, Kt to Q4. 8. P to QB4, B to R3. 9. P to Q Kt3, Castles; &c. From these two variations it may be seen that the advance of the KP does not result favourably for White. Steinitz played in his second game against Zukertort:—

5. Kt to QB3	5. B to Kt 5.
6. Kt × Kt.	6. KtP × Kt.

Now White proceeded with 7. B to Q3, P, Q4. 8. P × P, P × P. 9. Castles, Castles, and the game became even. Another way of continuing the attack is by playing 7. Q to Q4, which produces some exciting play.

7. Q to Q4	7. Q to K2
8. P to B3	8. P to Q4
9. B to KKt5	9. P to B4
10. B to Kt5 (ch)	10. K to B sq (best)
11. Q to Q2	11. P to Q5
12. Castles	12. P to KR3 (best)



Obviously Black could not take the Kt, on account of 13. Q to Q8 (ch). Black would not improve his game by playing B to Kt2; for, although White is thereby prevented from playing Q to Q8 (ch), he will have a good game—*i.e.*, 12. . . . B to Kt2. 13. Q to B4, P × Kt. 14. P to K5, with a strong attack.

13. B × Kt

If the B retires, then P to Kt4 follows, making room for the K, which then enables Black to play P × Kt.

	13. P × B
14. P to QR3	14. P × Kt
15. Q to Q8 (ch)	15. Q × Q
16. R × Q (ch)	16. K to Kt2
17. R × R	17. P × P (ch)
18. K × P	18. K × R
19. P × B	19. P × P

With an advantage for Black.

SPECIAL NOTICE.

Knowledge *in future will be published by* Messrs. Longmans, Green, & Co., 39 *Paternoster Row, London, E.C.*

Contents of No. 5.

TERMS OF SUBSCRIPTION.

"Knowledge" as a Monthly Magazine cannot be registered as a Newspaper for transmission abroad. The Terms of Subscription per annum are therefore altered as follows to the Countries named:—

	s.	d.
To West Indies and South America	9	0
To the East Indies, China, &c.	10	6
To South Africa	12	0
To Australia, New Zealand, &c.	14	0

To any address in the United Kingdom, the Continent, Canada, United States, and Egypt, the Subscription is 7s. 6d., as heretofore.

KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART

LONDON: MAY 1, 1886.

THE UNKNOWABLE.

By Richard A. Proctor.

WORSHIP OF THE PLANETS.

WITH the progress of time, it became clear to the worshippers of the sun and moon, that these orbs moved around the star-sphere according to definite laws. The idea might still remain that unless due prayers and sacrifices were offered up to each of them, they might be offended, and cease either for a while, or for ever, to pursue their proper circuits. But inevitably the thought would intrude that the sun and the moon were sure to move as they had been wont to do since men had first observed them, and that it was idle to pray for what was sure to take place. For uncertainty is a necessary element in prayer. Those who deem it right, nay, a duty, to pray for fine weather after long rains, or for rains after long drought, would not think of praying that the sun should rise to-morrow or ascend to his due height in the heavens as the year progresses; nor would they pray that he should stand still or in any other way behave as they know he never has behaved and never can. We can not only see from the sacrifices offered at the time of new moon, sunrise, sunset, and still more solemnly at the spring equinox and the autumn equinox, that in old times men thought it was worth while to try to keep the sun and moon in their proper courses by duly propitiating those heavenly bodies, but we know that so ignorant were they of the laws of the celestial movements, that they did not hesitate to pray the sun and moon *not* to move in their proper courses. As that exceedingly religious rhyme-writer, Robert Montgomery, did not hesitate to invite Deity to "Pause and think," so the medicine men of olden times were ready to request the sun and the moon to stand still, and either persuaded themselves, or tried to persuade others, that on occasions even such bold prayers as this had been answered. But though the earth-central idea left men freer to imagine such marvels to be possible than men can be in our time (except, of course, the ignorant) even the observant believer in the earth-central theory must early have become conscious that the sun and the moon move according to regular law, and will neither hasten nor check their movements in response to prayers or sacrifices.

No doubt most men in those days regarded such ideas as profane and blasphemous. As fossil-minded folk in our days proclaim that science is setting on one side the Almighty in the name of universal evolution, so would the ignorant of those old sun-worshipping and moon-worshipping days have lamented that their gods were being set aside in the name of uniform motion. We have only to consider the horror with which the Copernican theory and afterwards the theory of gravitation were received, to perceive what a shock there must have been for the worshippers of the sun and moon in the idea that these bodies have, each of them, their appointed paths.

But in the meantime other orbs would have attracted the attention of those persons—priests, astronomers, or whatsoever we may call them—who attended to the movements of the sun and moon, determining the times and seasons for sacrifices and for all other ceremonial observances. They found five other bodies travelling along the zodiacal track, already recognised as the highway of the gods.

Jupiter and Mars must first have been distinguished from the fixed stars by their movements, though Venus certainly attracted attention earlier by her lustre and her alternate appearance on either side of their great god, the sun. Even Mercury may have been noticed as a strangely moving body—never seen except near the sun, and passing rapidly from one side to the other—before Mars and Jupiter were distinguished from the fixed stars. We, indeed, seldom see Mercury at all, and never see him as a conspicuous orb; but in clearer and less humid skies than ours Mercury shines out resplendently, well justifying the name given to him by the ancient astronomers—the Sparkling One.

It may probably have been a long time before either Venus or Mercury was recognised as traversing the zodiacal track, which had been assigned to the sun and moon. On the contrary, Jupiter and Mars, so soon as they were distinguished at all from the fixed stars, would be seen to have the zodiac for their pathway. Later, Saturn would be distinguished as a planet, though it might be hard to determine whether he was probably first recognised as such through his movements or through the peculiar quality of his light, which distinguishes him in marked degree from the fixed stars.

So soon as the five planets had been recognised—one may almost say discovered—the priestly observers could not fail to regard those bodies as deities, like the sun and moon, as beings therefore to be propitiated by prayer and sacrifice. It was not merely as Wordsworth rather mildly puts it, that these "radiant Mercuries seemed to move, carrying through æther, in perpetual round, decrees and resolutions of the gods," but that they seemed to move as gods.

In some respects the planets would seem to be possessed of greater power than the sun and moon. These two orbs, though moving on the star-sphere, seemed obliged to move always in the same direction, and even on the self-same track, for it would be long before the varying path of the moon would be recognised. The other five moving bodies were free to pursue such tracks as seemed good to them, "now high, now low, then hid, progressive, retrograde, and standing still." In this freedom there must certainly have been recognised an element of power. Moreover, some of the planets were seen to travel with much statelier solemnity of motion than either the sun or moon, while every one of the five moved more slowly than the moon, which circles the star-spheres in $27\frac{1}{3}$ days. Comparative slowness or stateliness of motion would be recognised by those first observers (who supposed that everything they saw they must be able to interpret) as indicating superior dignity, if not superior power.

With regard to power, indeed, they would be quite prepared to believe that "great or bright infers not excellence." It is quite likely that the influences of the stars on the earth and on the fortunes of men and nations, were considered fully equal in importance to the influences of the sun and moon. And though the five planets might not pour heat on the earth, or raise tides, they might well be supposed to exert other influences, which though less obvious might be equally or even much more important. What

these were, the lively imaginations of those early observers quite readily determined. To the moon had been assigned the *rôle* of chief measurer of time, and potent influence on all belonging to the month; in the sun they recognised the chief ruler of the seasons, and the lord of wealth, because the produce of their fields, alike in tillage and in pasturage, depended manifestly on his power. The influences assigned to the planets were more subtle but not less potent. The ruddy Mars, with his strangely varying splendour, ruled the fortunes of war, exciting men to conflict, and in battle stimulating these and weakening those, according as the god was disposed to favour or to anger. Venus, most beautiful of all the planets as seen with unaided vision, growing more brilliant as the sky darkens, but languishing with the growing day

to faint in the light that she loves,
The light of the daffodil sky,

seemed as obviously to be the orb which swayed the hearts of men to love—a goddess, therefore, though perchance had women had the sexing of the planets, Venus would have been a masculine deity. The swift movements of Mercury, and the way in which he flashes into his greatest glory and anon hides himself amid the beams of the sun, suggested as naturally a deity moving men to brilliant subtleties, to craft and stratagem, if not to robbery and plunder. In regard to Saturn, again, there could be little doubt. The slowliest moving of all the planets known to the ancients, gloomy in aspect (though now known as most beautiful), what other position could be assigned him than that of a woe-working, penalty-inflicting deity, most to be dreaded if not most powerful of all the heavenly host? Jupiter's position and influence were probably determined rather by comparison with the other celestial bodies than by any suggestions derived from his aspect or movements. Considered in himself, indeed, he suggests glory and steadfastness, because he surpasses all the stars in brightness and all the planets of the *night* (Venus being never seen when it is actually night), while he moves so statelily that he is nearly twelve years in completing his circuit of the zodiacal pathway of the gods. But it is by comparing him with Venus for lustre, with Saturn for steadiness of light, and with the sun for stateliness of motion that the planet-worshippers of old came to assign to Jupiter his position as governing the fortunes of chiefs and rulers among men. If Saturn were gloomy and solemn, Jupiter was dignified and stately; if Venus gave love, Jupiter gave control; if the sun bestowed wealth, Jupiter bestowed power.

There were thus seven celestial rulers, diverse in power and influence, diverse also in dignity, the sun and moon, Mercury, Venus, Mars, Jupiter, and Saturn—the seven planets of ancient astronomy. How should these be classified? How could they be classified but by reference to that one quality which was common to them all, the quality distinguishing them from the fixed stars, their motion around their zodiacal roadway? Classed thus the planets would have the order :—

1. Saturn, most potent for *evil.*
2. Jupiter, most potent for *good.*
3. Mars, most potent in *strife.*
4. The Sun, most potent for *wealth.*
5. Venus, most potent in *love.*
6. Mercury, most potent for *craft.*
7. The Moon, most potent in working *change.*

How other relations would be recognised or imagined, and the metals, numbers, forms, and so forth, would be associated with the various planets, need not here be considered, though in passing I may notice that the readiness and completeness with which in old times they found out all about the planets, metals, numbers, geometrical figures, times, &c., &c., and the relations of these to each other and to the fortunes of individuals and of races, afford instructive illustrations of the confidence of ignorance. The nascent doubts of half-knowledge, and the gradual rising of doubt to its place as chief among the scientific virtues, would have been unintelligible to the men who confidently decided that there are seven metals each associated with one of the seven only planets, in the order quaintly stated by Chaucer :—

Sol gold is; and Luna silver we threpe;
Mars iron; quicksilver Mercury we clepe;
Saturnus lead; and Jupiter is tin;
And Venus copper, by my faderkin.*

When the five planets had been associated with the sun and moon as deities of the same order, it naturally followed that the sacrificial system was extended to include all seven orbs. Set times and seasons were appointed for the ceremonial observances belonging to the heavenly rulers of the world.

The year having been already assigned to the sun, and the month to the moon, the only way in which the planets could be dealt with, in regard to set times, was by assigning to them the days and the subdivisions of the days. The week already existed, we may be sure, for among all ancient races we find this natural division of time by a rough approximation to the times of new moon, half moon, full moon, and half moon again. Most probably, however, at its first beginning, the week really was marked off by these phases, and not, as later, by seven days. In semi-savage days there would be no greater inconvenience from the occasional lapse of a day to get the weeks right with the moon than before the beginning of chronological exactness there would be any trouble in throwing in a few days to make the year right, as in the rough-and-ready calendar systems of the *ancient* ancient Egyptians. Probably, as accurate observations of the moon came to be made, the idea of making a lunar month thirty days, instead of roughly calling it four weeks, and so having in each month six weeks of five days, may have arisen. Nay, we know that among certain nations this change was attempted, and that in a proportion of these it was successfully introduced. The five planets proper would then doubtless have been assigned to the five several days of the week. But among races which retained the week of seven days, and substituted the uniform succession of such weeks for the mere fourfold division of the actual moon-circuits (from "new" to "new") all the seven moving orbs would be associated with the week, each as governing its own particular day. If by this time, as must certainly have happened, the day itself had been divided into portions, then, as these would have to be assigned severally to *their* celestial rulers, a certain difficulty would arise. For even as the first hour of each day symbolises the glory of the sun as natural Ruler of the Day, so if each planet is to rule a day in some more artificial system, the first hour must be the special hour besides belonging to the special day of that planet's rule. And the hours of each day must also be assigned in uniform succession—seven hours by seven hours—to the seven planets. We may assume the early division of the day into twenty-four hours, though probably daytime was divided into twelve equal hours and night-time into twelve equal hours, only equal to the hours of daytime at autumn and spring.

We can easily set ourselves the problem which was set the ancient planet worshipper. There are seven days, each

* It is noteworthy that in Numbers xxxi. 22, 23, where six of the metals corresponding to the seven planets of the ancients are mentioned, we have after gold and silver, which naturally are put first, the remaining four in the order of the distances of the corresponding planets—viz., brass, iron, tin, lead.

of twenty-four hours, and we want the hours assigned in succession to the seven planets taken in some suitable order, and each of the seven days assigned, by its first hour, to a different planet. But so soon as we have selected a suitable order for the planets—that, namely, indicated above—the problem practically solves itself, as the following table shows:—

Saturn .	1	8	15	22	5	12	19	2	9	16	23	6	13	20	3	10	17	24	7	14	21	4	11	18
Jupiter .	2	9	16	23	6	13	20	3	10	17	24	7	14	21	4	11	18	1	8	15	22	5	12	19
Mars .	3	10	17	24	7	14	21	4	11	18	1	8	15	22	5	12	19	2	9	16	23	6	13	20
Sun .	4	11	18	1	8	15	22	5	12	19	2	9	16	23	6	13	20	3	10	17	24	7	14	21
Venus .	5	12	19	2	9	16	23	6	13	20	3	10	17	24	7	14	21	4	11	18	1	8	15	22
Mercury .	6	13	20	3	10	17	24	7	14	21	4	11	18	1	8	15	22	5	12	19	2	9	16	23
Moon .	7	14	21	4	11	18	1	8	15	22	5	12	19	2	9	16	23	6	13	20	3	10	17	24

Here I have simply counted the hours in order—seven by seven—after the order of the planets, and also 24 by 24. The first day is sacred to Saturn (our Saturday), and its first, eighth, fifteenth, and twenty-second hours are also sacred to the gloomy and malign god. The first known of the second set of twenty-four is sacred to the sun, to whom therefore the next day (or Sunday) is sacred. So, following out the series of hours, we find the third day sacred to the moon, giving Monday; the fourth to Mars, giving *Martis dies*, or *Mardi* (with us Tuisco's day, or Tuesday, Tuisco being the Scandinavian Mars); the fifth day to Mercury, giving *Mercuris dies*, or *Mercredi* (our Woden's day, or Wednesday); the sixth day to Jupiter, giving *Jovis dies*, or *Jeudi* (our Thor's day, or Thursday); and finally, the seventh day to Venus, *Veneris dies*, or *Vendredi* (our Freya's day, or Friday).

Of course, among races who had long worshipped the sun and moon, Sunday and Monday would be taken as the first two days of the week (probably a method of distributing the days and hours which brought these two days together would be regarded as a heaven-sent revelation). And it would seem very natural to regard the day which fell to the gloomy and slow-moving Saturn as suitably coming last, and a proper time to rest after the week's work, especially as any work on the day ruled by so malignant a heavenly body would naturally be deemed unfortunate if not wicked —probably unfortunate first, wicked in later days. Hence among the ancient Babylonians, Egyptians, and other races of the more civilised sort, arose the Saturday rest or Sabbath, which certainly was enjoined in Chaldæa, Assyria, and Egypt, centuries before the less civilised and less intelligent Hebrew race became acquainted with the institution.

The Jewish system of sacrifices and ceremonial in regard to the Sabbath and the new moon, may be considered to indicate the nature of the original Sabæan system, notwithstanding the obvious attempt made by the Jewish legislators to get rid of the worship of the heavenly host, even while retaining its ceremonial and many of its most peculiar forms and ideas.

(*To be continued.*)

Hunting as Sport.—Few human characteristics speak more clearly of our descent from savage and brutal ancestors than the habit of regarding the pursuit of animals as sport. Of course the pursuit of animals for food may be regarded as legitimate, and the pursuit of destructive animals for the purpose of destroying them and removing a source of danger is also legitimate; but to regard even these methods of slaying our fellow-creatures as sport is degrading and barbarous. It would be in like sort degrading if men who make researches by the method of vivisection were to take actual pleasure in the operations by which their "subjects" were tortured. Regarding vivisection properly conducted as legitimate, we yet expect the vivisectionist to diminish as much as possible the sufferings of the creatures on which he has to experiment. If he gloated over such sufferings, we should despise him as a brutal savage. But we cannot logically avoid the same decision in regard to the man who recognises sport in the chase and slaughter of wild animals.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By Edward Clodd.

VII. PRESENT LIFE-FORMS.

If the life-forms of the past somewhat baffle us by their scantiness and imperfectness, those of the present embarrass us by their abundance. But although the existing species of plants and animals are numbered by hundreds of thousands, and the tale is not yet complete, they are classified into a few primary divisions or sub-kingdoms representing certain allied types, of which the several species included in each sub-kingdom are modified forms. For example, flies and lobsters, beetles and crabs, are grouped in the sub-kingdom of the Annulosa, because they are alike composed of distinct segments; boys and frogs, pigs and herrings, are grouped in the sub-kingdom of the Vertebrata, because they alike possess an internal bony skeleton, the most important feature of which is the spine or vertebral column. And this classification, as remarked already, is applicable alike to past and present organisms, there being throughout the whole series of fossil remains no form, however unlike any existing living thing, that is not to be placed in one or other of the sub-kingdoms.

Moreover, a fundamental unity underlies and pervades the whole, a unity of material, of form, and of function, the differences between organisms, from the slime of a stagnant ditch to the most complex animal, being in degree and not in kind. Therefore, although each genus, nay, in most cases, each species, needs for its complete study the labour of a life-time, it suffices for the majority of us, grateful for the results which the zeal of specialists has achieved, to acquaint ourselves with the essential characteristics which mark the main divisions of the twin sciences of Botany and Zoology. Not only is this the only possible thing for us; it is the one thing needful for all, specialists and non-specialists, otherwise the significance of facts, in their relation and dependence, is missed; the larger generalisations are swamped in a sea of detail; we cannot, as the phrase goes, see the wood for the trees.

In the old definition of the three kingdoms of nature, the mineral, the vegetable, and the animal, we were taught that plants grow and live, while animals grow, live, and move. But this no longer holds good, at least in respect of the lower forms. There are locomotive plants and stationary animals. The swarm-cells or zoospores which are expelled from some of the lower plants, as algæ and certain fungi, behave like animals, darting through the water by the aid of hair-like filaments called vibratile cilia, finally settling down and growing into new plants; others, as diatoms and desmids, are locomotive throughout life; certain marine animals, as sponges and corals, are rooted to the spot where they grow; while there are organisms which appear to be plants at one stage of their growth, and animals at another stage.

Other marks of supposed unlikeness have vanished. It was formerly held that among the distinctive features of animals are (1) a sac or cavity in which to receive and digest food; (2) the power to absorb oxygen and exhale carbonic acid; and (3) a nervous system. But although nearly all animals, in virtue of their food being solid, have a mouth and an alimentary cavity, there are certain forms without them, and although plants, in virtue of their food being liquid or gaseous, need not that cavity, there are plants that have it. Not only is the process of digestion apparent in the leaves of carnivorous plants, but embryonic forms have been found to secrete a ferment similar to the ferment in the pancreatic secretion of animals, and by which they dissolve and utilise the food-stores in their seed-lobes as completely as food is digested in our stomachs. And

although green plants, under the action of light, break up carbonic acid and release the oxygen, they do the reverse in the dark, as also in respiration; while the quasi-animal fungi, which are independent of light, absorb oxygen and give off carbonic acid.

In the "irritability" of the sundew, Venus's fly-trap, and other sensitive plants, still more so in subtile and hidden movements in plant-cells, we have actions corresponding to those called "reflex" in animals, as the contraction of the shapeless amœba when touched, or the involuntary closing of our eyelid when the eye is threatened, or the drawing back of one's feet when tickled. The filament in the amœba which transmits the impulse causing it to contract differs only in degree from the sensory nerves in ourselves which transmit the impression to the motor nerves, causing the muscles to act; and since there is every reason for referring the contractile action of plants, *i.e.* their movements in obedience to stimulus, to like causes, the germs of a nervous system must be conceded to them. The minute observations of Mr. Darwin and his son into the large class of quasi-animal movements common to wellnigh all vegetable life go far to confirm this. The highly sensitive tip of the slowly revolving root, in directing the movements of the adjoining parts, transmitting sensation from cell to cell, "acts like the brain of one of the lower animals; the brain being seated within the anterior end of the body, receiving impressions from the sense organs and directing the several movements."

In these and kindred vital processes, in the so-called sleep of leaves, and the opening and closing of flowers, both regulated by the amount of light, apparently acting on them as it acts on our nervous system; in the detection of subtle differences in light, which escape the human eye, by plants; in their general sensitiveness to external influences, even in the diseases which attack them, the study of which Sir James Paget has commended to pathologists, we have the rudiments of attributes and powers which reach their full development in the higher animals, and therefore a series of fundamental correspondences between plant and animal which point to the merging of their apparent differences in one community of origin.

In fine, that which was once thought special to one is found to be common to both, and to this there is no exception. Not only is there correspondence in external form in the lower life-groups, but, fundamentally, plants and animals are alike in internal structure, and in the discharge of the mysterious processes of nutrition (although, as will be shown presently, this forms a convenient line of separation) and of reproduction. All, from the lowest to the highest, have their unity and kinship in ancestral life which was neither plant nor animal.

Of course the difficulty of classifying vanishes in the higher forms; the lowest plants are allied to the lowest animals, but the higher the plant the more it diverges from the animal, which is evidence that in the succession of life the highest plants do not pass into the lower animals. Descent is not lineal, but lateral; the relations between the two kingdoms are represented by two lines starting from a common point and spreading in different directions. Even "lower" and "higher" are relative terms; the organisation of the amœba is as complete for its purpose as is that of the man for his purpose, the modification in the complex forms being due to the division of functions which are performed in every part by the simple forms.

Although the foregoing and numberless other facts, together with the law of continuity, alike forbid the drawing of any hard and fast lines, and involve the conclusion, to borrow Professor Huxley's words, "that the difference between animal and plant is one of degree rather than of kind, and that the problem whether in a given case an organism is an animal or a plant may be essentially insoluble," there exists, exceptions notwithstanding, a broad distinction in the mode of nutrition.

"All things the world which fill
Of but one stuff are spun,"

and this stuff, the basis of all life, the formative power, is a semi-fluid, sticky material, full of numberless minute granules in ceaseless and rapid motion, to which the name "protoplasm" (Gr. *prōtos*, first; *plasma*, formed) has been given. It consists of four of the elementary substances, carbon, hydrogen, oxygen, and nitrogen, complexly united in the compound called *protein*, which is closely identical with the albumen or white of an egg. These are the *essential* elements, but a few others enter into the chemistry of life, with slight resulting differences in the *incidental* elements in animals and plants. As water is necessary to all vital processes, a very large proportion enters into living matter.

But there is this fundamental and significant difference between the two kingdoms. The plant possesses the mysterious power of weaving the visible out of the invisible: of converting the lifeless into the living. This it does in virtue of the chlorophyll, or green colouring matter, which is found united with definite portions of the protoplasm-mass, of which it is a modification, the exact nature being unknown.* The water and carbonic acid which the plant absorbs through the numberless stomata or mouth-pores in its leaves or integument are, when the sunlight falls upon them, broken up by the chlorophyll,† which sets free the oxygen, and locks together the hydrogen and carbon, converting this hydro-carbon into the simple and complex cells and tissues of the plant, with their store of energy for service to itself and other organisms. Animals, a few low forms excepted, cannot do this; they are powerless to convert water, salts, gases, or any other inorganic substances, into organic; they are able only to assimilate the matter thus supplied by the plant, nourishing themselves therewith either directly, by eating the plant, or indirectly, by eating some plant-feeding animal. In other words, the plant manufactures protein from the mineral world, and the animal obtains the protein ready-made; the plant converts the simple into the complex; and this the animal, by combining it with oxygen, consumes, using up the energy it thereby obtains in doing work. So the plant is the origin of all the energy possessed by living things, but why it can by virtue of the sunshine convert the stable inorganic into the unstable organic, while the animal cannot, we do not know. Neither do we know whether plant preceded animal, or *vice versâ*, in life's beginnings, although the evidence, which will be considered in its place, seems to point in favour of the priority of the plant. Structurally the lowest animal is below the lowest plant, since it is a speck of formless colourless protoplasm, whereas the protoplasm of the lowest plant is organised to the extent that it has formed for itself an outer layer or membranous coat called the cell-wall. For example, the vegetable character of yeast-granules is determined, apart from their mode of nutrition, by the protoplasm being inclosed within a cellulose coat, and the animal character of the amœba, not because of contractile or locomotive power or of inability to manufacture protein from inorganic matter, but by the absence of any such covering. Upon this Haeckel remarks that the vegetable cells sealed their fate when inclosed within a hard thick cellular shell, being thereby less accessible to external influ-

* Chlorophyll is found in green fresh-water polyps and a few other small animals, but is thought to be due to a vegetable parasite.

† The formation of chlorophyll in complete darkness, but under sufficiently high temperature, has been observed in a few instances.

ence, and less able to combine for the construction of nervous and muscular tissues than the animal.

But since the function creates the organ, and where function is not localised there is no variation of parts, life probably began in formless combinations having no visible distinction of parts. And as the cell is the first step in organisation, it is the fundamental structure of living things, "it marks only where the vital tides have been and how they have acted," the lowest organisms consisting of one cell only, and the higher consisting of many cells, which, increasing in complexity or diversity of form adapted to their different functions at later stages, are modified into the special tissues, with resulting unlikeness in parts or organs, of which all plants and animals are composed. Every variation in structure is therefore due to cellular changes, and every living thing is propagated in one way or another by cells, by their self-division or multiplication; or by gemmation, *i.e.*, throwing off buds: or by the union of like cells: or, in more complex mode, by the spontaneous or aided union of unlike cells, as the sperm-cell of the male with the germ-cell of the female, giving rise to a seed or egg from which grows offspring more or less like its parents. The importance of embryology in explanation of the laws of development will be dealt with later on.

In both plant and animal the cell-contents usually, although here again exceptions occur in some of the lowest organisms, exhibit a rounded body called the *nucleus*, which itself often incloses another body called the *nucleolus*, the functions performed by both of which in cell-development are obscure. That even thus much is known of cell structure may awaken wonder when it is remembered that we are dealing with bodies for the most part beyond the range of our unaided vision. Bacon truly says that "the complexity of nature exceeds the subtlety of man"; the infinite divisibility and indivisibility of matter is apparent in the organic as in the inorganic; and size counts for little; the oak and pine, the acacia and the rose, are lower in the scale of life than the thistle and the daisy; the elephant is 150,000 times heavier than the mouse, but the egg of the one is nearly as large as that of the other, and it has been calculated that if one molecule in the nucleus of the ovum of a mammal were to be lost in every second of time, the whole would not be exhausted in seventeen years.

These molecules are the sufficing material media of transmission of resemblances, both striking and subtle, between parent and offspring; and of the vast sum-total of inherited tendencies, good or bad, which are the product of no one generation, but which reach us charged with the gathered force of countless ancestral experiences.

> Born into life! man grows
> Forth from his parents' stem,
> And blends their bloods, as those
> Of theirs are blent in them:
> So each new man strikes root into a far fore-time.

ANIMAL WEATHER-LORE IN AMERICA.

By CHARLES C. ABBOTT, M.D.

IN reference to the dog, I have heard the following pretentious stanza, which has now taken its place among our nursery rhymes, where, indeed, it is best fitted to remain:—

> When drowsy dogs start from their sleep,
> And bark at empty space,
> 'Tis not a dream that prompts them to,
> But showers come on apace.

Here we have essentially the same inference as in that of the rhyme about cows, but it is not to be explained away so readily. Such acts as described cannot be attributed to annoyance by flies, for they too often emerge from dark quarters, where they have been unmolested; but the all-important fact must not be overlooked that such acts are not confined to summer. If they were, the electrical theory might be advanced with some confidence. From what I have noticed in such dogs as I have owned, the habit of dreaming—which in the rhyme is denied to be the explanation—is probably the key to the mystery. Again, statistics show that the correspondence between such habits and sudden showers is only what we should expect in the way of coincidences. Dogs certainly are not to be considered as reliable barometers.

The same may be said of the domestic cat. Its movements have all been carefully noted, and the yawning, stretching, scratching, and waving of the tail appear to have been accredited with some special meteorological significance. Careful observation has not confirmed any of these impressions. Table-legs are scratched time and again by Tom or Tabby, and no rain falls for twenty-four or forty-eight hours. They stretch themselves after a nap, lick their sides and wash their faces with the same regularity in midwinter as in midsummer, yet it is only showers, and not snow-storms, which these actions are supposed to predict.

When in summer the signs fail, my country friends conveniently forget the remark they have made; but, if the day does prove showery, my non-combative neighbours take much delight in repeating over and over again, "I told thee so," with a suggestive emphasis, showing how much, like other people, they love to gain a victory, if open warfare can be avoided.

The only weather-rhyme referring to a cat that I have heard, and which is essentially the same as that about dogs, runs thus:

> When Tabby claws the table-legs,
> She for a summer shower begs.

That is, begs it will hurry, with no doubt in her mind of its possibly disappointing her.

The weather-lore of the commoner wild animals is of much more general interest. Weather-sayings referring to animals do not appear to have been so numerous as are those referring to birds. I have been able to learn of but three examples. In reference to minks and weasels I have heard it said, and possibly others may be familiar with this mystic rhyme:

> When storm-winds blow and night is black,
> The farmer may a pullet lack:
> But, if the moon is shining clear,
> No mink or weasel dares come near.

This involves an interesting phase of the life-history of these animals: for while they probably can see a little when it is quite dark, and are safely guided by the sense of smell, nevertheless, the experience of trappers about home proves that they do wander about during moonlight nights. Indeed, on careful inquiry, it seems that the trapper generally anticipates better success during the moonlit nights than when it is very dark. I strongly suspect that the truth lies in the fact that, when it is dark and stormy, the watchful house-dog is not on the alert, and thus the cunning weasel or mink is free to raid upon the poultry-house and feast upon the pullet that it seizes. How my neighbours will take to this explanation I can only surmise. Like other people, they fight vigorously for the opinions they have cherished through life. The musk-rat and grey squirrels have given rise to many trite sayings, and have long been looked upon as weather-prophets, but that they are nothing of the sort I have elsewhere * endeavoured to show.

* "Rambles about Home," p. 73, D. Appleton & Co., New York, 1884.

The following may or may not be a local saying:—

When flying-squirrels run on ground,
The clouds 'll pass you by, be bound.

What this may mean has been a question with me for a long time. It is a common remark, either in this or a simpler form, and many, who have little faith in pigs or dogs as weather-prophets, build largely upon the habits of the flying-squirrel. The saying itself implies that a drought exists at the time that these animals frequent the ground rather than the trees, coming, of course, thereto in order to find food. If the saying be true, the summer food of the flying-squirrel must be more plentiful on the ground than in the tops of the tallest trees. What that food is exactly I am not aware, nor have I had any opportunity to verify the statement that flying-squirrels frequent the ground during "dry spells." Those that I have seen near home are so strictly crepuscular that only the initial movements of their nocturnal journeys are readily traced; but, whenever I have seen them sally from their retreats, it was to take a tree-top route for several rods and then to be lost to sight. Take the year through, it is probable that they seldom come to the ground to forage. When they do so, is it an evidence of continued dry weather? I can neither contradict nor affirm; but are not the probabilities against such being the case?

Speaking of the opossum, it is said that, if found in autumn in hollow trees, the winter will be milder than if occupying a burrow in the ground.

This seems to be very reasonable, and would pass admirably as a weather-sign but for one unfortunate circumstance. While you may find one or more in a tree, your neighbour may find as many in the ground. I have known this to be the case more than once. Under these circumstances, meet your neighbour at the line-fence and compare notes. What about the winter?

From their greater abundance and never-failing presence, it might be thought that the weather-lore of birds would be much more elaborate than that referring to other classes of animals; but my observations do not confirm this. There are simply a greater number of sayings current, and fully one half are too trivial to repeat. It would seem as if a weather-lore possibly of Indian origin and referring to birds then abundant, but now wholly wanting, was current more than a century ago. These sayings were subsequently applied to other species, nearly or more remotely allied, and whatever meaning they may originally have had has been lost; but the apparent absurdity of such "proverbs," as now used, seems never to have occurred to those who repeat them.

That the clucking of chickens, cackling of geese, and the "potracking" of Guinea-hens have not given rise to an elaborate series of weather-proverbs is, I think, surprising. The only familiar reference to the chicken heard about home is that the rooster, crowing at night, says, "Christmas—coming—on!" It does appear that the midnight crowing of cocks is more frequently heard in December than in June; but, so far as the meaning is concerned, it unfortunately happens that the nocturnal crowing is as often heard in January as in December. Calling attention to this, I was once gravely assured that the cocks crew differently then, and said, "Christmas—come—and—gone!" I accepted the explanation. This is not a weather matter, but is not irrelevant, as it shows how very common it once was to couple any unusual occurrence with something sooner or later to happen, and therefore, in the matter of weather especially, to claim it as prophetic of that event.

Of the examples of weather-lore of birds, the following are not uncommonly heard in Central New Jersey. Of the cardinal-grossbeak, or winter redbird, it is said:

The redbird lies, without regret:
However dry, it whistles "wet!"

That is, the bird is credited with knowing it will not rain, and teases the farmer by singing "wet" in his ears all day. Others put another meaning on the redbird's note, and claim it to be a sure sign of rain. This is more like the ordinary sayings commonly heard, and let us give it a moment's consideration. At present, the time of year when the cardinal-birds sing least is during the hot summer months. Not that they are absolutely mute for even a few days at a time, but relatively so as compared with their joyous strains through autumn and winter; and again, early in summer, when they are nesting, these birds, like robins, are more apt to sing directly after a shower than at any other time.

So much for the gay cardinal as a weather-prophet. The rare summer redbird—a tanager—which also utters a whistling note, well described by the syllable "wet," shortly and sharply expressed, is likewise said to prophesy rain. The probabilities are that the note of the redbird, cardinal and summer, suggesting the word "wet," has given rise to the belief that their utterance was a sign of a coming shower or storm. It is often by such illogical methods that these sayings have become established. After a few repetitions they become fixed in the mind and their origin forgotten; they are invested with an importance not their due, and not attributed to them by their originators. Ultimately they are incorporated in the weather-lore of the country.

Of the innumerable swallows, it is said, with as little show of reason:

No rain e'er poured upon the earth,
That damped the twittering swallow's mirth.

No? Well, of late, the whole host takes refuge from storms—the barn-swallows in the hay-mow, the cliff-swallows under the eaves, the sand-martins in their burrows, and the chimney-swifts in their sooty homes in the chimneys. Why this change of habit? For a wonderful change must have taken place if the couplet quoted was ever true. I do admit that swallows and swifts appear to be noisier before and during a shower; but does not this arise from the fact that at such a time they collect in great numbers near their nests to take refuge if the storm should increase in violence? And again, the silence of other birds makes the twittering swallow a more prominent bird than under other circumstances; but nothing of this warrants the extravagant assertion that no storm ever put a quietus upon them.

The larger hawks, too, are supposed to give warning of a coming shower when they utter their peculiar cat-like scream. Among our old people the following may sometimes be heard repeated:

The hen-hawk's scream, at hot, high noon,
Foretells a coming shower soon.

This couplet is of some interest, as, at present, it is not applicable to our larger hawks and buzzards. Indeed, the only one of them that is prone to cry out while circling overhead is the red-tailed buzzard or hen-hawk, and this bird is very seldom seen in midsummer, and now certainly is only heard in autumn, winter, or early spring. The saying implies that formerly these birds were abundant at all times of the year, and during the summer would cry out in their peculiar fashion. The settlement of the country and general deforesting of such a large portion of it have driven these hawks to more retired parts during the nesting season, and there, throughout summer, their cry may indicate that it will soon rain; but, if so, why does not the same cry in autumn have some reference to the weather?

It is scarcely necessary to continue the list. Other birds than those mentioned—reptiles, batrachians, and fishes—

have all given rise to certain current sayings, but of no more value than those I have given, and all, I think, based upon illogical inferences. Snakes are claimed as excellent barometers; but the habits upon which the belief rests are those that characterise every day of the creature's life. Toads and frogs are largely depended upon, but a careful record for a single season will show how little they are to be trusted; and even the fishes cannot disport themselves in summer but straightway the clouds must open upon us, a tornado visit us, or premature frosts balk the calculations of the farmer.

Curiously enough, I do not find that insect life has entered to any important extent into the weather-lore of this neighbourhood. Contradictory remarks are often made as to ant-hills: thus, when they are very high, it will be a dry day; others insist that it is evidence that it will soon rain. Spiders' webs, also, are variously held as of barometric value; but a careful record of several summers contradicts this emphatically. The positions of the paper-hornets' nests, which in autumn are often prominent objects in the country, after the foliage drops, are variously asserted to be indicative of a "hard" or "open" winter, as they chance to be placed in the upper or lower branches of a tree. My scepticism as to the value of this sign arises from the fact that there is, as might be expected, no uniformity in the positions of any half-dozen such nests.—*Popular Science Monthly.*

COAL.

By W. Mattieu Williams.

THE MEASURES ABOVE AND BETWEEN THE COAL.

In my last I described the vegetable deposits that are now occurring in the Norwegian fjords and certain lakes, and stated my reasons for concluding that such deposits must ultimately become true coal seams; that they present us with an actual and natural demonstration of how coal seams may be formed, and how they probably were formed, during the carboniferous period, under far more favourable conditions of climate, and therefore more rapidly and effectively. So far, I have only described the operation of laying the trees on the beds of the lakes and fjords, with no other covering than the water; this, of course, suggests an apparent difference between the present and the past, the ancient coal seams being buried under deposits of mineral matter, so attached and connected with them as to indicate that the action of vegetable deposition and that of mineral deposition must have somehow been alternate. Is there any such action at present proceeding in connection with the present-day coal formation that I have described?

I am able to answer this question. Some typical cases are supplied by the arms of the Sogne fjord, which I have already mentioned as displaying good examples of the vegetable avalanches. This great inlet has been well compared, so far as ground-plan outline is concerned, to the trunk of a tree with many branches and twigs. The branches are the lateral fjords, some of great depth and walled with perpendicular rocks, such as the Nerö fjord; others with steep slopes, more or less wooded. The twigs are the rivers or torrents with which all these arms terminate, usually many such torrents to each of the branches, and each torrent, of course, flowing along the bottom of its own valley.

One of the most magnificent of these valleys is the Justedal. It is rarely visited by tourists, having no roadway for carrioles and no stations. It proceeds upwards to the Justedalsbrae, the largest glacier ground in Europe (500 square miles of ice), and the summit region of Scandinavia, the Jotunhjem (the home of the giants). I came upon this valley from above, in 1856, after a rather adventurous solitary walk (see "Through Norway with a Knapsack," chapters x., xi., xii.), and on reaching the lower part of the valley found a sudden and curious contrast to the desolation of ice and snow and glaciated rock I had just left. This change was due to the fact that I had now arrived at the original terminal boundary of this arm of the fjord, the ancient shores of which were as definitely marked as though the water were still there. Instead of the water surface there was a level plain richly cultivated with luxuriant pastures and heavily-laden fruit trees. The cause of this transformation is evident at a glance. The Storelv (the big river) which starts from a gloomy, ice-bordered lake, the Styggevand, and receives contributions from half a-dozen glaciers, on its way down the Justedal, is turbid with rock débris. So long as it continues its brawling course between moraine boulders, the stirring keeps these particles suspended, giving it the characteristic milky appearance of such streams; but when it reaches the calm water of the deep fjord, these particles drop to the bottom, cover the previous deposit of fallen trees, and finally fill up the fjord to the topmost level of its waters. I carefully traced this deposit to the present shores of the fjord, and on bathing traced it further still as an extensive subaqueous plain, stretching right across this branch of the fjord. This plain being covered with turbid water, its level will go on rising until it will become high and dry and cultivated right across from Ronnei, to Marifjören on the opposite side.

I have thus fully described this instance because it is a characteristic example of what is going on more slowly and less strikingly in every one of the thousands of terminal branches of the Norwegian fjords. These plains are so characteristic as physical features of Norway, that they have received a special name, *Ör*, or, with the definite article attached, *Ören*. Thus Laerdalsören, the sands of the Laerdal; Sundalsören, the sands of Sundal; Bolstadören, Dalsören, Viksören, Gudvangsören, &c., &c. They are usually sandy, varying according to the rocks over which the river flows and the degree of glaciation to which they may have been subjected. Such deposit, of course, covers the vegetable deposit that may have preceded it at the bottom of the fjord, and it is continually, though very slowly, advancing. If the present conformation and physical conditions continue for a few hundreds of thousands of years, most of the Norwegian fjords will be filled up and their places occupied by extended ör. They correspond to the deltas which are formed when rivers flow directly into the open sea.

Lakes are similarly filled up; the vegetable deposit of the Achensee is being similarly silted over at the end where the river enters. Such lakes are merely expansions of the river itself where it comes upon a deep outstretch of its valley. The shores of the Lake of Geneva have advanced six miles from the original boundary of the upper end of the lake, and, as Lyell says, "we may look forward to the period when this lake will be filled up." Similar examples might be multiplied indefinitely.

The whole of the north-west coast of Norway, including all the fjords that branch inward therefrom, and all the valleys above the fjords, display a most interesting series of terraces. A steep slope of recent deposit, commonly glacial "till," rises from the river at the valley bottom like a railway embankment, then a flat, then another bank topped by another level, and so on in a series of steps up to a height of 600 feet above sea level. If any of my readers visit Norway they should observe these. They are magni-

ficently displayed from the railway between Trondhjem and Stören, where the line crosses many of these valleys with the step terraces extending up them and visible for miles. They show that all these valleys within a geologically recent period have been under water, were arms of fjords 600 feet deep at their present mouths, and there are evidences to show that several alternations of rising and falling either of the land or the sea level have occurred.

We have only to suppose that similar conditions existed in the carboniferous period to account for the covering up of the lowest of the coal seams and the redepositing and recovering of other seams in successive alternations of the level of such fjords or long, steep estuaries—always remembering that the climate of the carboniferous period (proved by its vegetation) was vastly more favourable to luxuriant vegetation than that of arctic and sub-arctic Norway.

There is no difficulty in accounting for the isolated trees, reeds, &c., found in the coal-measures—some lying down, some upright, and others inclining at all angles. The silting would take place at the upper end of the lake or fjord simultaneously with the occasional downfall of vegetable avalanches, and thus the trees and all other vegetation of the denuded slopes would be bedded in the mineral matter as we find them; the probabilities of upstanding position being largely increased by the fixing of the lower portion of those trees that had sunk in such position in consequence of the stony matter adhering to their roots. A curious result would be likely to follow in such cases. The tree thus standing upright, or moderately inclined, would be slowly surrounded by the mineral deposit, and at the same time be slowly decomposing. If this decomposition of the vegetable matter were completed before the tree became wholly buried its place would be occupied by a tube, and the unburied upper portion would break off, leaving the tube open at the top. Into this open tube mineral matter would of course descend, forming a core or column occupying the space formerly filled by the tree. Are such cores or columns ever found in the coal measures?

The following shows that they are:—"In a colliery near to Newcastle, say the authors of the 'Fossil Flora,' a great number of *Sigillariæ* were placed in the rock as if they had retained the position in which they grew. Not less than thirty, some of them 4 or 5 feet in diameter, were visible within an area of 50 yards square, the interior being sandstone, and the bark having been converted into coal. The roots of one individual were found imbedded in the shale, and the trunk, after maintaining a perpendicular course and circular form for the height of about 10 feet, was then bent over so as to become horizontal. Here it was distended laterally, and flattened so as to be only 1 inch thick, the flutings being comparatively distinct. Such vertical stems are familiar to our miners, under the name of coal pipes. . . . These coal pipes are much dreaded by our miners, for almost every year in the Bristol, Newcastle, and other coal-fields, they are the cause of fatal accidents. Each cylindrical cast of a tree formed of solid sandstone, and increasing gradually in size towards the base, and being without branches, has its whole weight thrown downwards, and receives no support from the coating of friable coal, which has replaced the bark. As soon, therefore, as the cohesion of this external layer is overcome, the heavy column falls suddenly in a perpendicular or oblique direction, from the roof of the gallery whence the coal has been extracted, wounding or killing the workman who stands below."—Lyell's "Elements of Geology," pp. 478-79 of fifth edition.

Such a tube penetrating the bottom deposit and suddenly opened when the upper part of the partially decomposed or rotted tree fell down would naturally fill up to a given depth in a shorter time than would be necessary for the formation of the same depth of deposit all around it, as the river stream bearing the solid matter drifted over it. If there were variations of material in the strata (as are found to occur), these would not be represented inside the tube; all its materials would belong to the period succeeding the exposure of its mouth. This is confirmed by the usual structure of these coal pipes. Sir Charles Lyell describes, in the work above quoted, the interior stratification of several of such trees which differ from the strata around them. In one example "the layers of matter in the inside of the tree are more numerous than those without; but it is more common in the coal measures of all countries to find a cylinder of pure sandstone—the cast of the interior of a tree—intersecting a great many alternate beds of shale and sandstone, which originally enveloped the tree as it stood erect in the water."

Many of the trees found in the coal measures have the tubes of a species of *spirorbis* or *serpula* (marine worms that cover themselves with an envelope or shell of limestone, and live within it), showing long immersion in salt or brackish water.

As regards the composition of the strata immediately covering the coal seams, Lyell says: "The more closely the strata productive of coal have been studied, the greater has become the force of the evidence in favour of their having originated in the manner of modern deltas. They display a vast thickness of stratified mud and fine sand without pebbles, and in them are seen countless stems, leaves, and roots of terrestrial plants, free, for the most part, from all admixture of marine remains—circumstances which imply the persistency in the same region of a vast body of fresh water."

We must remember that the thickness of these deposits above the coal seams is very great, from 600 to 12,000 feet in the British Isles. The theory favoured by Lyell, that the coal is formed by rafts of vegetable matter—like those of the Mississippi—brought down to the open sea and there deposited *at, or a little above, surface level*, demands enormous subsidences and upheavals, which could scarcely have occurred thus on the open sea-shore without completely marine conditions prevailing during some parts of the time. Besides this, a raft of pure vegetable matter as free from mineral material adulteration as ordinary coal, and extending over some hundreds of square miles, demands a very big river indeed. I read a paper on this subject at the Birmingham meeting of the British Association in 1865, and a very lively discussion followed, in which Sir Roderick Murchison, Sir Charles Lyell, John Phillips (the President of the year), and Principal Dawson took part. Lyell advocated the raft theory, and some amusement followed when this difficulty of finding a river big enough was raised, and was connected with his own published accounts of the probable insular conditions and climate of the period of the coal measures.

One of the most characteristic—I may say the specially characteristic—mineral deposit of the coal measures is that which the miners call the "linstey" or "linsey" rock, from its resemblance to the striped fabric, linsey, which is the usual material of their wives' skirts. It is a sandstone striped with dark, black lines due to fibres of carbonaceous matter. Some of these stripes are very thin. I hope to have an interesting illustration of this rock in my next paper. My explanation of the formation of this rock is that during the winter or other flood periods of its formation the white non-carbonaceous streaks were deposited in the fjord or lake, and that during other periods, when but little mineral silt was deposited, the vegetable matter from the wooded hillsides, was deposited through the comparatively clear water

near the shores (this striped rock does not appear to cover the whole width of great seams).

It should be noted that the explanation of coal formation above given does not at all contradict the received conclusions of geologists concerning the existence of swampy plains upon which grew the giant reeds, the tree-ferns, &c., found in the coal measures. These, according to my view, grew upon the sedimentary plains corresponding to the sandy plains, the *ör*, on which the upper ends of the Norwegian fjords terminate, and which, under the climatic conditions of the coal formation, would form just such plains as are ordinarily described. My only point of difference is that these were not the grounds upon which grew the scores or hundreds of generations of trees which must be accumulated in order to form a thick coal seam itself. That the conditions under which a seam of coal containing only 1 or 2 per cent. of mineral matter to 98 or 99 of vegetable origin was formed must be quite different from that in which was formed a mineral rock in which the proportions are reversed, 98 or 99 mineral to 1 of vegetable, is so obvious that it seems almost a folly to insist upon it. Nevertheless it is necessary to do so, as a mere inspection of the diagrams of the "coal fossils" usually printed prove, and the fact that most readers accept these as necessarily displaying the particular plants of which the coal itself is formed. If I am right, the coal itself was formed of trees and other vegetation of steep slopes; while the fossil specimens of the coal-measure rocks must consist of some of these (such as would be swept down during the deposit of the sediment), and of others of a very different character—viz., those which grew upon the swamps that were formed when the deposit nearly reached the water level. This reconciles the fact that we find conifera, which do not flourish in swamps, side by side with plants peculiar to swamps.

A DEAD WORLD.

By Richard A. Proctor.

THE ancients fell into strangely incorrect ideas about the heavenly bodies. They chose the most beautiful of all the planets, beautiful alike in symmetry of shape and delicacy of colouring, as the emblem of misery and gloom, regarding Saturday, the day sacred to that planet god, as one on which all work was unfortunate. They took, on the contrary, the most disappointing and unsatisfactory of all the sun's family, as a fortunate orb, the emblem of love; and although, strange to say, the day devoted to this planet (Friday) also, was deemed unfortunate for beginning a great work, or starting on a long journey, that was only because the next day, devoted to the unlucky Saturn, compelled rest; and it is naturally unlucky to begin a great work if in a few hours you will have to rest from it.

In like manner the ancients looked at the full moon, and because she was pale, and seemed so "silently and with so wan a face" to climb the sky, they thought she was cold. "Ice-cold Dian" she seemed to them at the very time when her surface, as modern science shows, is hotter a good deal than boiling water. I say this of the full moon in perfect consciousness that an American physicist, Mr. Langley, with an instrument which he calls the bolometer, finds the full moon colder than ice. I reject the evidence of that too delicate heat-measurer, and prefer the well-attested teachings of the trustworthy old instrument, the thermopile, whose work has been tested and measured again and again and never found wanting in correctness. With too delicate a balance, you do not always know what moves it; a breath may make some light substance you are weighing seem twenty times as heavy, or as light, as it really is. And so, I suspect, it has been with Mr. Langley's unpleasantly named heat-measurer. Some unobserved change near at hand has made the bolometer tell of cooling, where it should have told of heating if it had really recorded the influence of the moon's beams. Once an astronomer who supposed his delicate heat-measurements were telling him of the heat of stars, found that in reality he had been carefully measuring the heat generated by friction as he turned his telescope towards the star. Mr. Langley was making, we may be well assured, a similar mistake. Of course he thoroughly believes in the results he has obtained; so fully does he believe in them that, supposing the cold he has found in the full moon to result from the thinness of the lunar air, or the absence of any air on the moon, he adopted the belief that rock surfaces at a great height above the sea-level do not get warm under the sun's rays, as science asserts. It was on a lofty peak of the Rocky Mountains, report says, that he maintained this argument. "*A priori* reasoning," he said, "may seem to show that these rocks around us must become hot under the sun's rays, but science should trust more in *à posteriori* evidence, the argument from observed facts,"—here he sat down, but for a singularly short time, on one of the rocks to which he had referred—"I—I stand to it," he is reported to have continued, with some appearance of irritation, "despite of arguments, *à priori* or—or otherwise—that the moon must be intensely cold when she is full; for my bolometer says so, and my bolometer is never mistaken."

Sir John Herschel had long since shown, by a process of simple reasoning, that at the time of lunar midday the moon's surface must become at least as hot as boiling water. The present Lord Rosse, using one of the fine telescopes which his father constructed (not, as has been mistakenly alleged, the great Parsonstown reflector*), arrived at a result corresponding to that which any one acquainted with the laws of physics could have anticipated. He ingeniously separated the heat which the moon reflects from the heat which she radiates—that is, which she gives out as a warm body will. He found that the surface of the moon at lunar midday is 500 degrees hotter than the same surface at lunar midnight. (I mean degrees Fahrenheit, of course; for the general reader, however intimate he may be with the rules for converting Centigrade or Réaumur, prefers to have no occasion to apply them.) Dividing these equally—as is only fair—on either side of nothing, we have a range from 250 degrees below nought, or 282 degrees below freezing, to 250 degrees above nought, or 38 degrees above boiling! We may get less cold, by dividing unequally; but then we get so much the more heat, and that would be quite unnecessary; or we may get less heat, but then we get so much the more cold, and 250 degrees below zero would be cold enough in all conscience. The stoutest among us would be killed by ten seconds of such cold, as surely as he would be killed by one second in boiling water. The moon, which passes through the whole range of this

* "Along whose tube a tall man may walk without stooping," it is the custom to add. Doubtless, for a tunnelling along which tall men may walk conveniently, the great Rosse telescope is the best in existence. But regarded simply as an "instrument for observing the heavenly bodies," which perhaps is more nearly what it was meant for, the "mighty mirror of Parsonstown" is not so satisfactory. If Sir William Herschel's great 40-feet telescope "bunched a star into a cocked hat," Lord Rosse's still larger instrument played worse pranks still with the planets. "Zey show me somedings," said a well-known German astronomer, pathetically describing his experience at Parsonstown, "zey show me *somedings*, and zey say, 'He is *Saturn*': *and I believe zem.*"

change in a fortnight, is assuredly not a desirable place for creatures so unfortunately sensitive as we are to changes of temperature.

All this, however, is not new but old. Till Mr. Langley came and set many doubting with his dreadful bolometer, no one imagined that there could be life on a planet undergoing the vicissitudes of temperature which Sir John Herschel had correctly indicated, and Lord Rosse had demonstrated. That the moon, whatever her past history may have been, must now pass monthly through amazing vicissitudes of heat and cold, is certain, let Mr. Langley's bolometer say what it may. It is with the moon's past history we are concerned at present, not with these effects of the sun's action on the moon's dead body.

For dead the moon assuredly is, *now*. It is as clear that there are none of the characteristics essential for life—as water, air, and reasonable ranges of temperature—on the moon at present, as it is that her surface has in the past been the scene of tremendous disturbance. That dead body of hers, carefully examined, with due regard to the evidence which our earth also can give about planetary existence, may tell us as much as a post-mortem examination might tell the keenly observant anatomist of the past life of a human being. What may have been the precise features of the various eras of lunar life we may no more be able to tell than the anatomist can tell what thoughts passed through the brain which he dissects with his scalpel. But the broad outline of human life we may trace as surely as that anatomist can follow the stages by which the body he dissects had reached its final condition, before death invaded life's sanctuary.

It is here that, as it seems to me, new thoughts are suggested by knowledge recently acquired.

The argument from analogy has, I think, been somewhat too narrowly applied to the moon and other planets, when they have been compared with our earth. In assuming that each planet has its youth, its mid-life, its old age, and finally its death, astronomers have doubtless been right enough; but I think it by no means so clear that they have been right in assuming (tacitly, perhaps, but still confidently) that the various stages in the lifetime of one planet resemble the corresponding stages in the lifetime of another. A dog has stages of life corresponding to those of a man; but a puppy is not a baby or even like one, a young whelp is unlike a lad, a dog is not a human being, and even a dead dog presents no very marked features of resemblance to a defunct man.

I propose to consider here some points in which, most probably, the moon's life-history must have been entirely unlike the life history of our earth. The considerations I shall urge may be applied, it will be found, to other planets as well to those which are larger than the earth as to those which, like the moon, are very much smaller.

I begin with some of the simple considerations involved, such as those relating to size, surface, substance, and so on.

Every one knows that the earth contains eighty-one times as much matter as the moon. I might dwell on the consideration that in gathering together her larger mass the earth must have become very much warmer than the moon ever was, even when the moon was at her youngest and hottest. For the celestial bodies owe their heat to their own energies in gathering their mass together; and the greater the gathering energy the greater the developed heat, as certainly as the stronger a blacksmith's arm the greater the effect of his blows.

It would seem even that we have evidence of a still greater deficiency of original heat in the circumstance that the moon not only had less energy with which to gather together her substance, but that having gathered it together, she has packed it less closely than the earth. If the moon were as compact as the earth she should have only an 81st part of the earth's volume. As a matter of fact she has fully a 49th part. The earth put in a suitable balance (I cannot indicate any suitable place for setting it) would be found to weigh about five and a half times as much as a globe of water of the same size. But weighing the moon, three and a half globes of water as large as the moon would bring down the scale on their side.

Starting thus in her career of life with much less heat than the earth, the moon would cool also much more quickly. I do not mean by this that she would give out more heat moment by moment than the earth did at the same stage of her life; but that she would be cooling faster in the same sense that a cupful of hot water cools faster than a bowlful, and a spoonful faster than a cupful. This is easily seen if we compare the moon when red-hot with the earth also red-hot, neglecting the effect of the air of either body in keeping in the heat, as clothing keeps in the heat of the human body. We may be sure that the consideration thus neglected does not affect the general result; for certainly the moon was not better clothed (atmospherically) than the earth, at any corresponding stages of their lives—but the reverse. Our red-hot earth, then, had eighty-one times as much heat at that red-hot time than the moon at that (other) time when *she* was red-hot. And the earth was giving out thirteen and a half times as much heat, moment by moment, as the moon; for in that degree her surface exceeds the moon's. Now, if a man has 81,000*l.*, while another has but 1,000*l.*, and expends daily 13*l.* 10*s.*, while his poorer friend can only afford to expend 1*l.* daily, the property of the former will last six thousand days, while that of the latter will, in one thousand, be completely exhausted. The richer man's money would last six times as long as that of the poorer man. The earth's heat would, in the same way, last six times as long as the moon's, at each stage of the cooling process.

In this way the moon would manifestly age very fast as compared with the earth. If we imagine the moon and the earth at the same stage of planet life six millions of years ago, then in a million years from that time, or five millions of years ago, the moon was where the earth is now. What will five millions of years do for us, or rather for our home? But even that way of putting it is not quite strong enough. Those five millions of years in the moon's history would correspond to six times as long—or to thirty millions of years—in the history of the earth! Our globe will show marked signs of advanced age by the end of that time, I venture to predict, in calm assurance that, at any rate, I shall not be contradicted by the evidence of observed facts. She would then be as far advanced in planetary life as the moon.

Like the well-known calculation about wine, made under (pretended) vinous influence for *All the Year Round* several years ago, this calculation may be modified, yet the result come out unchanged. If I remember rightly, that calculation began: "Let us suppose there are eighty casks, or it may be eight hundred, or, perhaps, eight thousand," and so on. We might have begun our calculation by saying, Imagine the moon and the earth at the same age six millions, or it may be sixty millions, or perhaps six hundred millions of years ago. It really does not matter. Take the longest period. Six hundred millions of years ago the earth and moon were in the same stage of planetary life. Then we find that five hundred millions of years ago the moon had reached the stage now reached by the earth, and three thousand millions of years hence the earth will have reached the same condition as the moon. Is not this, the

reader may ask, a very different result from the former? On the contrary, it is precisely the same result! For, by our present assumption, the rate at which either planet ages is only one-hundredth of the rate we had before assumed. Hence the three thousand millions of years in our result indicate an amount of aging equivalent only to that resulting in thirty millions of years according to our former assumption.

Since, then, we are quite certain of this, that the time when earth and moon were equally advanced in planetary life must be set millions of years ago, we are at least certain also of this, that our earth will not be so old as the moon now is, she will not be so wretchedly decrepit (if not so utterly dead) a world until many millions of years have passed.

So far as this reasoning is concerned, the moon might have passed through a life much like that of our earth. She might well have had a life-bearing period akin to that through which the earth is passing at present. True, the various stages of her life would be very much shorter, and we can very well believe that, therefore, the various forms of animal life which have been developed on the earth would not have had the same chance of being properly developed on the moon. Or, considering the progress of a single race —our own—we can very well imagine that a being like man on the moon would not have had sufficient time to pass through all the stages by which man has passed from the arboreal, hairy, pointed-eared, and four-legged ancestry now assigned him, to the civilised man of to-day, inventing every year more perfect instruments for destroying his fellows. The Lunarian, thus understood, may have been no better fighter than the man of the caves, or even than the more advanced fighters among the anthropoid apes, our cousins. In other words, he may have been a perfectly contemptible creature, instead of a being of murderously imperial instincts.

But now a consideration comes in which suggests the idea that at no time could the forms of animal and vegetable life on the moon have resembled those on the earth. We must apportion to the moon no more than her fair allowance of water, no more than her fair allowance of air. And when we have done this, we find strong reason for thinking that, though that allowance of water and of air may have done very well for the Lunarians, it would not have done at all for us.

Let us begin with the water. The moon would have had one eighty-first part of the quantity of water which formed our earth's share. So far, good. That seems altogether fair. But observe. Our earth, with eighty-one times as much water, had a surface only thirteen and a half times as large over which to distribute that water in seas. It needs not even the ghost of Cocker to show that the earth had six times as much water per square mile. That of itself must have sufficed to make a very marked difference between the moon's condition *then* and our earth's condition now. Nor does it seem at all likely that at any stage, either earlier or later, the moon would have had a better chance of doing well in the universe than she had then—that is, at the time when she had reached the same stage of cooling which the earth has reached now.

But the want, or the short allowance, of water was as nothing compared with the thin air the Lunarians, if there ever were any, had to breathe.

Of course, as regards quantity of air, the reasoning is the same precisely as for water. Only one sixth part of the quantity of air which we have on this earth per square mile was (on the average) above each square mile of the moon. On the earth this would be a most serious matter. For the density of air depends on the weight of the total quantity above the surface; so that the density of the air would be reduced to one sixth part if the quantity of air above each square mile were no greater here than it probably was on the moon, in the corresponding part of her planetary life. Now in the highest ascent above the sea-level which men have yet made—the celebrated balloon ascent by Messrs. Coxwell and Glaisher—the height attained was within a very few feet of the height of Mount Everest, the highest known peak of the Himalayas. At that height the air was reduced to little more than one-fourth its density at the sea-level. Mr. Glaisher fainted, and, if he had been alone, it would have been all up with him, even though the balloon might eventually have come down. Mr. Coxwell remained conscious, however. Nay, with creditable zeal for science, he even urged the fainting meteorologist to "make one other little observation, now—*do*," to which, however, Mr. Glaisher only responded by fainting dead away. Mr. Coxwell began, he tells us, to feel rather blue. Looking at his hands, he perceived that they were quite blue. They were also powerless, which was an even more serious matter; for it was necessary that the valve-strings should be pulled, if the conscious and the unconscious aeronauts were to be saved. Mr. Coxwell was equal to the occasion. Seizing hold of the valve-string with his teeth, he drew it—feebly indeed, but still so that it worked—and the balloon began to descend. He had saved himself and his companion, but only as by the skin of his teeth. Certainly this proved that no man could live, even for a few minutes, in air of only one-sixth of the density of the air at our sea-level—for that would be but two-thirds as dense as the air whose rarity so nearly killed our aeronauts.

Even this, however, would be as nothing compared with the tenuity of the lunar air, if we are right in supposing that, at the corresponding stage of her planetary life, the moon had the same allowance of air as compared with her mass that our earth has now. For, the smaller quantity of air would be drawn down with smaller force, gravity at the moon's surface being only one sixth part of gravity at the surface of our earth. Instead of the lunar air having one-sixth, it would only have one thirty-sixth, of the density of our air at the sea-level. Air so thin would not only be unbreathable by creatures like ourselves: it would not support any kind of life known to us on earth, except such life as there is (if life it can be called) in rotifers and other such creatures, which can not only live with the smallest possible allowance of air, but resist with apparently unimpaired cheerfulness the action of a roasting heat and a much more than freezing cold, and can neither be boiled nor baked, nor drowned nor desiccated, to death.

Consider, again, some of the unpleasant results of such extreme rarity or tenuity of the air. It may seem rather a convenience than otherwise that the mercurial barometer would be only five-sixths of an inch in height. But the water barometer, instead of being, as with us, about thirty-three feet in height, would have a height of less than one foot. Now this in itself would not signify, but it would mean (and this *would* signify) that one foot would be the extreme height to which a suction pump would raise water. What a nuisance that would be! especially, too, where, as we have seen, water would not be very plentiful, and wells would have to be dug deeper than on the earth to reach it. Then drinking would be much more difficult—which might, however, be as well, where water would be so hard to get at—for in drinking we exhaust the air on one side of the water in our drinking-vessel (the air inside the mouth), and the air on the other side (outside the mouth) obligingly presses the water into the mouth, where we want it to go. But the air outside would not do this with sufficient energy if its density were reduced to one-sixteenth; so that, in order to drink, one would have to tip the drinking-vessel up till

the water ran out into the mouth, which would be, to say the least, an inelegant and unseemly way of drinking.

In passing we may notice that, were it not for the unpleasant deficiencies here mentioned, creatures much larger than any on the earth might exist on the moon. A Brobdingnag on the earth would be by no means the terrible monster imagined by the inventive Captain Gulliver. From what is now known about the relation between the strength and the size of muscles, a Brobdingnag ten times as tall (and also ten times as broad and as thick) as a man, would be one hundred times as strong; but he would be one thousand times as heavy. Thus he would be ten times as heavy as he ought to be, and would be just about as active as a man among ourselves who, weighing 140 lbs. (10 stone), had his weight increased by overloading to 1,400 lbs. The extra 1,260 lbs., or rather more than half a ton, would certainly not conduce to activity, insomuch that, when Gulliver first saw a Brobdingnag, he might have been sure that the creature's show of giant size must be hollow, or else its weight so great that movement would be impossible. Now on the moon such a Brobdingnag would weigh only $233\frac{1}{3}$ lbs., and, so far as power of movement is concerned, would be like a man of 140 lbs. weighted down with only $94\frac{2}{3}$ lbs. Even this would be an awkward extra weight. But a lunar man six times as tall as one of ourselves would be all right, for he would be thirty-six times as strong, and also thirty-six times as heavy, so that he would be just as active as one of us. He would be no such contemptible giant as Jack the killer of giants dealt with so easily. He would stride six yards as easily as a man on earth strides one yard; he could leap over a height of 24 feet as easily as an active youth leaps over a four-feet stile. The work he could do as a lunar engineer or road-maker would be something stupendous. With as much ease as a man on earth can raise a block of stone six inches in length, height, and breadth, our lunar man could raise a cubical block one yard in the side, for such a block which on the earth would be 216 times as heavy, would on the moon be but thirty-six times as heavy, and the lunar man would be thirty-six times as strong. A lunar Great Pyramid, representing the same amount of work as the Great Pyramid of Egypt, would be 1,500 yards in the side and 970 yards high. It would remain in the dry, thin air of the moon for as many hundreds of thousands of years as our Great Pyramid has lasted thousands; and as it would be quite easily discernible with our telescopes, even with those of moderate power, there might, after all, be nothing very stupendously absurd in old Gruithuysen's idea that some of the features on the moon were the work of former lunar inhabitants. But unfortunately, these large lunar men would have wanted plenty of air and plenty of water, especially when at work on great lunar edifices; and if our estimate of the moon's past condition is sound, there would have been but very little water for them and still less air.

Perhaps all this may seem very little worth considering. Of such speculations there is no end, said Sir John Herschel—after indulging in them to his heart's content. And certainly it seems somewhat idle to discuss the ways of lunar men, when we have every reason to think that, in a world whose various stages of life lasted so short a time as the moon's, no such creature as man could possibly have been developed, even if there had been the requisite supply of air and water. Let us rather consider, therefore, whether what is actually seen on the moon may not find its explanation in the circumstances we have been examining.

(*To be continued.*)

EXAMPLE OF RECENT CELESTIAL PHOTOGRAPHY.

WE give this month a process engraving from a photograph by MM. Paul and Prosper Henry, of a rich region of the constellation Cygnus. It may be said to have been engraved by the stars themselves, the original photograph being the direct work of the stars, and the present reproduction derived from that photograph without the intervention of any human handiwork.

Next month we shall give process copies of the photographs of the Pleiades by the same astronomical photographers, showing the nebulous masses around Merope and Maia, accompanied by drawings of the same regions as observed by Tempel and Wolf.

HOW THE BIBLE CAME TO US.

By a Student of Divinity.

IT would be interesting to learn the average opinion of Bible readers about the *nature* of the Bible. Even in these days we take it that ninety-nine out of a hundred—nay, the full hundred out of nine hundreds in ten—regard the Bible as a book whose two parts, the Old Testament and the New Testament, form complete records, one given as a revelation to the Jewish people, the other as a revelation to the Gentiles. Fully as large a proportion of Bible readers, if further asked *why* they regard the Old Testament and the New as alike God's Word, would have no answer ready, except that it would be sinful to doubt it.

The real facts—let the interpretation of them be what it may—are somewhat different from what those imagine who are most earnest in talking about the Bible, but care least to learn what it really is.

Up to the time of Josiah, thirteenth in descent from David, there was no recognised collection of sacred scriptures other than what was called the Testimony, described in Deuteronomy xxxi. 12 as "the Book of the Law, put in the side of the ark of the covenant of the Lord." Probably the Testimony was simply the Decalogue, and those warnings and exhortations Moses had been enjoined at sundry times (see Exodus xvii. 18) "to write for a memorial in a book, and rehearse in the ears of Joshua." This Testimony, whatever it included, was given to each king at his crowning, and doubtless, before the kings' days, to each ruler at his appointment. And as, in our times, each monarch at his coronation hearkens to a certain more or less solemn statement of his duties, and as solemnly undertakes to fulfil them, so the judge, and later the king of the Jewish people, accepted the Testimony in token that he meant to obey its injunctions. It is not recorded that most of the kings fulfilled their promise in this respect,—rather the reverse.

In the days of Josiah the Book of the Law was found in the Temple by a certain priest, Hilkiah, who delivered it to a scribe, Shaphan, who, in turn, read it to the king, who was very much troubled to find that the things enjoined in this Book of the Law had been very much neglected—the cause, he at once saw, of the troubles which had fallen on the Jews for a long time past. (In those days they always knew how "bad times" were brought about.) So the king sent Hilkiah and Shaphan, with others, to Huldah, a prophetess, or "wise woman," of the sibylline type. This lady oracularly interpreted the whole matter. At her suggestion

The Centre of this Region is in Right Ascension 19h. 55m., North Dec. 37° 45′.

Photograph of a "Rich Region" in the Constellation Cygnus.
(Three Exposures of One Hour.)
Reproduced by a Photographic Process without Hand-Touching.

the Book of the Law was read to the people; the priests who had been ordained in Judah to burn incense "to the sun, the moon, the planets, and the stars" were put down; "the chariots of the sun," whatever they may have been, were burned, and "the horses given by the kings of Judah to the sun" were taken away; the priests of the high places were slain and men's bones were burned upon their altars (to defile them); the wizards and mediums ("those that had familiar spirits"), and the teraphim or ancestral idols, were put away. Everything, in fact, was done to appease the anger of Yahveh-Elohim, though unfortunately without avail; for we read that, "notwithstanding, Yahveh turned not from the fierceness of his great wrath wherewith his anger was kindled."

Around the Book of the Law, so long neglected, and freshly brought out under these striking circumstances, other old records were collected—we know not by whom. Whether they had the authority of Hilkiah the priest or Shaphan the scribe, or Huldah the sibyl, for their authenticity as the inspired work of God, no one knows.* We know only that they were the remaining books or documents forming the Pentateuch and the story of Joshua's victories. Even at this stage, however, diversities of opinion existed as to the value of the several records. The Samaritans accepted the Pentateuch and rejected the Book of Joshua. One would like to know their reasons in detail. Unfortunately we do not. We know only that during the two centuries between the time of Josiah and the time of Nehemiah the sacred documents had increased considerably in amount; for Josiah could hardly have read the whole Pentateuch, as we are told he actually did read the discovered Book of the Law, aloud to all the people.

One would like also to know who they were who during these two centuries weighed these other documents, and were moved to pronounce them God's own word. Let us at least hope that thoroughly trustworthy opinions were pronounced on that point in that age, uncritical though it was. For if not, we have to rely on opinions formed by men who in later times, with greater acumen, and perhaps wider knowledge, had also too personal an interest in the matter to be entirely free from the possibility of being biassed. A rather serious difficulty arises, of course, from the consideration that much of the material subsequently included among the sacred writings (God's very own Word!) must have existed in the time of Hilkiah, the high priest, and Huldah, the wise woman, and yet somehow failed to be recognised by these experts (may we assume?) as inspired.

Time passed, and again the Book of the Law was read to the people. It was after the restoration, and the time was that of the Feast of Tabernacles. Since the days of Joshua, the son of Nun, we are told, this feast had not been kept as it should have been; but now the people made booths, as had been enjoined—probably in far earlier times than even the priests themselves suspected. They did this because now the fuller law had been read to them by Ezra, as Nehemiah relates, with interpretation (popularised as it were), and the people had been much moved when they heard it.

This "revival," as Mr. Matthew Arnold calls it, brought into the canon the Pentateuch and the Book of Joshua. Doubtless the Book of Judges, and the Books of Samuel and Kings, then existed; but the glamour of antiquity and mystery had not yet surrounded these and other documents in the Temple chests, so that as yet it had not been discovered that they were written by divine inspiration. We know, in fact, that Nehemiah started a library, which probably he regarded as altogether secular. He put into it (2 Maccabees ii. 13) works which he had collected outside the Book of the Law and Joshua, viz. "matters relating to the kings and the prophets, and David's matters, and letters to the kings about offerings."

When a sufficient time had elapsed, it was discovered that these documents also were inspired—all except the letters to the kings about offerings. So *they* were included in the growing canon of the Old Testament. This was not done on Nehemiah's authority; nay, he may be said, by omitting to include them among the sacred books, to have practically excluded them, just as Hilkiah and Huldah had to all intents and purposes excluded still older books which later became the Holy Scriptures.

The new matter thus added to the Bible included the Books of Judges, Samuel, and Kings; the books of Isaiah (or, rather, of the two Isaiahs), Jeremiah, Ezekiel, and the twelve minor prophets; and the Psalms,—not all of them David's, but all so far associated with his name as to be called "David's matters" (*τὰ τοῦ Δαβίδ*).

Judas Maccabæus is responsible for the next addition to the sacred Scriptures. Among "the things lost by reason of the war we had," were the Books of Daniel, Job, Proverbs, and other documents, including all those which the Protestant Bibles add to the books already mentioned. A strange feature in the list of additions thus made is that while it included books like the Proverbs, the Song of Solomon, and Ecclesiastes, which must have been known in the time of Hilkiah and Huldah, and must have been old lore to Nehemiah, so that they had been practically rejected for centuries by all the leading religious folk as certainly not inspired—whatever other excellent qualities they might have—it included also the Book of Daniel and others which were actually contemporary with the introduction of the new series. This series closed, and still closes, in the Hebrew Bible, with the Books of Esther, Daniel, Ezra, Nehemiah, and Chronicles, an arrangement which very suggestively indicates the value assigned to the last three books by those who thus included them in the sacred canon!

There the record for the Old Testament ends. One can readily see, however, that the books written by Jews during the next two centuries would have been added in due time to the canon, if misfortunes had not unhappily interrupted the development of the holy Jewish scriptures. The mere fact that the Greek Jews wrote in Greek and not in Hebrew would have made little difference to the Jewish people, who until the fall of Jerusalem had a rare faculty for regarding all the writings by men of their own race as inspired! The Books of Baruch and Tobit, Wisdom, Ecclesiasticus, and the two Books of the Maccabees, will bear comparison exceedingly well with the Books of Esther and Daniel, the Song of Solomon, Proverbs, and the two Books of Chronicles. Of course, to those who regarded the Hebrew language as specially sacred, as the language in which Yahveh-Elohim talked with Adam and Eve, with the Serpent, and (see Job) with Satan, the idea of including Greek books in the sacred canon must have appeared outrageous; but if the Jewish nation had but survived a century or two longer, the books of the Apocrypha would have taken a permanent place in the Old Testament. In fact, remembering that the Greek and Roman Churches include these books, while the Armenian Church includes the Book of Enoch, we are obliged to admit that the action of the English Churches in excluding them is somewhat perverse. Especially puzzling is the *crux* presented by the Epistle of Jude, long doubted, but now accepted as canonical; for this epistle quotes from the Book of Enoch as from

* We do not know how Hilkiah, or Shaphan, or even the wise woman Huldah, came to be infallible judges of what should be regarded as the Word of the Infinite, or why they held in less esteem the books which Nehemiah subsequently accepted as inspired.

Holy Scripture! Either Jude's epistle is God's inspired word or it is not. If it is, then so is the Book of Enoch, which he quotes as authoritative, saying that so Enoch "*prophesied*;" if it is not, then this epistle has no proper place in the canon of scripture. The Armenian Church alone, by boldly accepting the Book of Enoch, escapes this difficulty.

Such is the record of the canon of the Old Testament from the time when Moses received the ten commandments (written—as he says he actually witnessed!—by the finger of God, on stone), and wrote special injunctions, according to God's command, for the destruction of non-Jewish nations, to the time of Hilkiah the priest and Huldah the sibyl, thence to the time of Nehemiah and Ezra (whose testimony, however, cuts rather inconveniently both ways, supporting some books and opposing others), and onwards to the time of Judas Maccabæus, so far as Protestant Bibles are concerned, while we pass on a few centuries farther for portions of the Roman, Greek, and Armenian Bibles.

Surely a collection of books thus formed must be full of interest to all thinking minds. The student of science finds in these books an account of very ancient ideas about many of the subjects with which he deals; the student of history has here most valuable records; the student of literature and even the student of art have here a fund of valuable materials. To the reverent mind the thought of calling this rather incongruous collection the word of GOD may seem somewhat startling. Such a mind may even feel pained at the suggestion, and may shudder at the callous ease with which the less reverent assume that not only what is good and true and beautiful, but also what is cruel or crude, absurd or trivial, indecent or erroneous, nay, even what is obviously self-contradictory, in this collection of all that remains of Jewish literature before the capture of Jerusalem. came from the Being that they describe in the same breath as All-wise, All-merciful, All-pure, All-perfect. But the very incongruity of their ideas should prevent us from regarding such men as irreverent, still less as irreligious or wicked. Nor need we fear that a nation among whom are many of these unconscious, and therefore innocent blasphemers, must needs arouse the anger of Yahveh-Elohim. All things work according to law, and the Power from which all things proceed will not turn from uniform procedure according to law to acts of violence and injustice —as if that Power were "some angry man in the next street"—merely because the unwise proclaim their folly loudly. Their offence, in any case, is only against the principles of logic; and though, were their minds clearer, it would be profane and hideous blasphemy, we need not fear lest

> Some hysteric sense
> Of wrong or insult, should offend the throne
> Where Wisdom reigns supreme.

The books of the later covenant with which we have next to deal present a problem of another sort. We have here nothing like the range in time, nothing like the variety of subject, and nothing like the incongruity of method and of treatment which we find in the ancient Jewish collection.

This portion of our subject must be left, however, to another occasion.

(*To be concluded.*)

After formulating a dozen inconsistent explanations of some manifest and perfectly natural mistakes in ancient religious records, the weaker theologians proclaim that the difficulty has been long since met. One recalls a scene in *Punch* many years since where a defender of American honour, speaking of Pennsylvania bonds, says:—

> This debt we have *repudiated* long ago,
> 'Tis therefore *settled*,—yet thisyer Britisher
> Keeps for *repayment* worriting us still.

PRIZE-PIG HONOURS FOR SCIENCE.

BY RICHARD A. PROCTOR.

MR. RANYARD found himself a long way in advance of his time when he brought before the Astronomical Society a proposal for doing away with the award of medals in recognition of scientific work. He was told that the idea was revolutionary, and that a medal, though not inappropriate for a prize pig, is also a graceful recognition of researches supposed to be pursued with the object of increasing knowledge.

I was formerly outspoken for Mr. Ranyard's side of the question, but events which happened in 1872–73 rendered my advocacy of the more dignified view of the matter less easy to me than before. For in 1872 Sir Edmund Beckett (whom I then barely knew by sight, but later reckoned among my most esteemed friends) thought fit to put forward my own name for the prize-pig form of recognition I had objected to; and as the award was not confirmed a sort of sour-grapes tone might be suspected in any comments I might thereafter make upon the medal subject in my former manner. Yet, as the subject has been raised again by another, who is as certainly free from any such suspicion as my friends know me to be, I shall venture to make such remarks upon it here as experience and judgment alike suggest.

To outsiders it seems a very simple matter. Certain men are at work in various ways in astronomical research; a society of students of astronomy recognise special interest or value in certain of their results, and, selecting what they consider best, the society awards the only form of recognition which it can think of.

In actual practice, however, the matter is not so simple. This particular form of recognition, like others—as election to various offices in the society, and so forth—very readily lends itself to jobbery. Two men may agree to support each other alternately for—let us say—the presidentship of a learned society, an office which may be merely complimentary, or may be used as a stepping-stone to salaried posts. The presidentship of the Astronomical Society, for example, is not an office of emolument; yet it might conceivably be worked to transfer the master of a suburban school into a University professor, or in other ways to advance one who had little power to advance himself. So with the award of a medal. Directly of no value, such an award may be indirectly made very profitable. One often finds, indeed, the same persons who job in regard to office engaged together in regard to even so seemingly innocent a matter as the award of a medal.

But apart from jobbery, the award of a medal may be made—unfortunately often is made—a subject for quite other than scientific considerations. In the case, for instance, of the suggestion made in regard to myself, I fancy that more than one of those who supported me were partly, though perhaps unconsciously, moved by the thought that, if the medal were given to me (my work over the transit of Venus being included with stellar researches, then incomplete), it would be unpleasant for the man whose transit investigations I had unfortunately found unsatisfactory. This, of course, was an altogether wrong reason for voting in favour of the award. But of course the same consideration afforded an equally wrong reason for voting against it—though definitely urged in that direction, and, indeed, the consideration by which the five unfavourable votes were secured. This, however, was a mild case compared with some which have occurred. Indeed, remembering that the original object of medal-giving was to do something pleasant and graceful—not necessarily scientific—I can

see good reason why a medal should not be given if there is any chance that its award to one man will give pain to another, as in my case would admittedly have happened. But when we consider how recognition has been refused to Young, Draper, Secchi, and others, for no better real reason than that they had succeeded where others had failed, or that they had established results which others had long and persistently, not to say perversely, opposed, then we cannot but see that there is something risky about the fat-pig-prize system as applied to scientific research.

Then again, a medal may be used to discourage as well as to encourage scientific workers. It is effectively used in that bad way when the medal is given (as it nearly always is) to men who, either as observatory chiefs or as men of large wealth, are able to obtain important results independently of their individual exertions. A man writing alone, perhaps also contending against the constant pressure of the *res angusta domi*, may be making much greater sacrifice for science, though obtaining much less showy results, than one who can employ a section of a large staff to carry out investigations which he has only planned or perhaps planned so imperfectly that only as the work of subordinates has a correct method of research been developed. A man with twenty thousand pounds a year may, without any real sacrifice, devote five thousand a year to a scientific inquiry, and with most impressive results (obtained by "my assistants"), where another, with nothing a year but what he earns, may barely be able to secure a tithe of what he aims at, though sacrificing hours worth two-thirds of his income to his work. If, in awarding the fat-pig order of prizes, societies only encouraged the former class, all would be well. But, unfortunately, they manage to discourage the other class. To him that hath they give freely; from him that hath not they try to take even that which he seemeth to have.

Of course only the weak are thus affected. But men writing under great difficulties, and trying to work alone, are apt at times to *be* weak. Many know the feeling, and, not only know it, but have yielded to it. I could name half a dozen at least who have begun original work, and would have gone on with it if simply left alone; but when scientific bodies have pretended to examine their work, and, seeming to put it in the balance, have appeared to find it wanting (though perhaps it has been of so special a kind that not one of those who thus pretended to weigh it has known anything about it), they have been discouraged and have turned to other pursuits. As an instance, I might mention a department of solar research, from which one once active worker has entirely seceded because of precisely such discouragement as I have indicated.

The same may indeed be said of many of the so-called distinctions for which the weaker sort hanker. Take, for instance, office on the council of a society. This ought to be simply a matter of service. "We want the help of such and such a man," a society should in effect say, "and, if he is willing, we will get him to join our working council." But instead of that, we find office on the council regarded as a sort of distinction, and all sorts of small feelings at work in deciding whether a man shall be elected or rejected. I shall not easily forget, for my own part, the surprise and disgust with which, after sitting on the council of the Astronomical Society several years, and consenting at a great sacrifice to work as one of its secretaries, I found that I had unwittingly hurt the feelings of a number of others, who regarded me as stepping over their heads into those much-coveted offices. Very quickly, thereon, did I withdraw from all such interference with their happiness. But it ought not to be so.

And see how easily this unfortunate state of things may be worked to cause pain and annoyance, nay, even to seem to cast a slur on a man's ability or on his work. At the last election for the council of the Astronomical Society, three marked cases of the kind occurred. Mr. Warren de la Rue and Captain Wharton, Chief Hydrographer to the Admiralty, are both put on the list for election to the council; an opposition list is sent forth, and both are rejected. How can outsiders fail to draw the entirely erroneous inference that the decision indicated an opinion adverse to their merits on the part of the whole society? Then in the opposition list Sir George Airy is advanced as a candidate, and is not elected. This, which looks like a slur, has in reality no such meaning. But there is undoubtedly discouragement in such action on the part of a body supposed to represent astronomy in this country. I am for my own part satisfied that the influence of scientific societies is too often worked so as to tend more to the discouragement than to the advance of science. And I am confirmed in this belief by noting that not one series of scientific researches of any importance has attained success through the influence of any scientific body, or has even been materially helped by such influence.

ANALYSIS OF GENESIS.*

WE hail with pleasure this new translation and analysis of one of the most ancient records in existence. The Cuneiform inscriptions include some records far more ancient than the Book of Genesis, and there are Egyptian records which belong to still more remote times, but in the Book of Genesis documents of venerable antiquity are quoted. To the Pentateuch, says Matthew Arnold justly, many an old book had given up its treasures and itself vanished for ever. Writing "record" for "book," this is specially true of the Book of Genesis. No one can read it carefully through, even in the imperfect (though charmingly written) Authorised Version, without seeing that it is most complex and, as it were, variegated, in character. We seem to feel the sense of reverence with which the old collator of documents and records preserved in the sacred lore chests of the Temple went through their varied contents. Conscious as he must have been of their many contradictions, noting as he must how the same story was related of different persons, or different accounts given of the same events, he could not venture to excise or abstract. Believing all to be sacred, because most ancient, he puts all in, in such order as seemed to him least likely to bring the different records into manifest contradiction.

We cannot but sympathise with the sense of reverence thus shown. It is akin in character to the reverence with which many a man as years advance and knowledge grows regards the ways and thoughts of his parents and grandparents, conscious that in many respects the ideas they taught him were inexact, but unwilling to admit that consciousness even to himself and prepared to conceal it closely from all others.

Yet to us this willingness to be blind to ancient mistakes appears, when looked at aright, as after all a weakness. It is such a weakness as we often see in individual life, when the confident receptivity of the child is allowed to remain a characteristic of the grown man. We know now that knowledge was not altogether with the men of old, but

* The Book of Genesis: a Translation from the Hebrew, in which the constituent elements of the text are separated; to which is added an attempted restoration of the original documents used by the latest reviser. By François Lenormant. Translated from the French, with an introduction and notes, by the author of "Mankind: their Origin and Destiny." London: Longmans, Green, & Co.

grows from more to more, even while showing us as it grows how little it must ever be compared with the unknown. In this lesson, indeed, we see that wisdom as well as knowledge is ever growing from more to more, for in the consciousness of limited knowledge there is wisdom, while in the confidence of ignorance there is childlike folly.

Man of to-day is ready, being grown, to put away childish ideas. He feels free, being free born, to examine the ways and thoughts of old times; to see the real value of ancient records such as those collected in that Jewish library called the Old Testament. From them we learn how man progressed from semi-savagery towards civilisation, and in particular how those ideas which we call religious had their origin and development.

It is hardly necessary for us to remark that here the Book of Genesis can be viewed from no theological standpoint. We claim freedom to regard it as we would any other ancient work or collection of works. But, apart from all the theological questions which have become associated with the older books of the Hebrew Scriptures, there is a deep, though somewhat quaint, interest in reading these ancient records. They present problems of great difficulty, because of the strange way in which the editor or editors, who, after the exile, arranged the Pentateuch as we know it, worked into the various books the somewhat incongruous materials in their hands. It requires no close scrutiny to determine generally what is Babylonian, what Egyptian, in the portions of the Book of Genesis which are really foreign and have manifestly been only adapted to Hebrew history and Hebrew ideas. But this is only the beginning of the task of determining the origin of the various parts of that old book; for we have Hebrew records of matters strictly Hebraistic, wrought into one and the same book, with purely Egyptian and as purely Babylonian conceptions, and also obviously recorded at widely-different times in the development of the Hebrew race. Then we have passages the origin of which, and the date to which they must be referred, seem altogether to baffle conjecture, at least in the present state of our knowledge.

It may be said that on the whole the easiest parts of the Book of Genesis to interpret are those which relate to matters absolutely outside the history of the Semitic race. For here the traces of adaptation are obvious, and indeed it here matters little whether they are obvious or not, because we now know that the record has here been derived essentially from without. Moreover, the post-exilian editors have been at very little pains to harmonise the diverse records. They probably knew that the people for whom they collated the work would not be unduly critical; and they did not know, nor would they perhaps have greatly cared if they had known, that alien races, the Gentiles whom they were taught to hate as a religious duty, would one day be reviling, execrating, and persecuting each other over questions arising from the interpretation of the crude and fantastic notions of the Egyptian and Babylonian persecutors of the Jewish people.

Among the portions of Genesis which can thus be now referred to their separate origins, the cosmogonies woven into the beginning of Genesis, and the history of the Flood, may be specially cited.

It is clear that in the first two chapters of Genesis as now arranged we have two entirely distinct conceptions of creation. The one which comes first in Genesis belongs in reality to a far later time than the other. The earlier account is commonly described as the Jehovistic, while the later is called the Elohistic, because in one the creating and arranging power is spoken of as Yahveh-Elôhîm, while in the other it is called Elohim (a plural form not necessarily involving a plural idea); but it should be remembered that these names were alike Hebrew in origin (though Yahveh was probably the god of the Hittites). The Egyptian and Babylonian traditions were doubtless Hebraised by those who originally transcribed them (the Egyptian traditions long before the Babylonian), and retained their several forms when collated after the exile.

The older record is obviously Egyptian in origin. It runs, as translated in the book before us, as follows :—

"In the day that Yahveh Elôhîm made earth and heaven, no bush of the field was yet in the earth, and no herb of the field had yet sprung up: for Yahveh Elôhîm had not caused it to rain upon the earth, and there was not a man to till the ground: but there went up a mist from the earth, and watered the whole face of the ground.

"And Yahveh Elôhîm formed man of the dust of the ground, and breathed into his nostrils the breath of life; and man became a living soul.

"And Yahveh Elôhîm planted a garden eastward in Eden; and there he put the man whom he had formed.

"And out of the ground made Yahveh Elôhîm to grow every tree that is pleasant to the sight, and good for food; the tree of life also in the midst of the garden, and the tree of the knowledge of good and evil. And a river went out of Eden to water the garden; and from thence it was parted and became four heads.

"And Yahveh Elôhîm said, It is not good that the man should be alone; I will make him an help answering to him.

"And out of the ground Yahveh Elôhîm formed every beast of the field and every fowl of the air . . . but for man there was not an help meet for him.

"And Yahveh Elôhîm caused a deep sleep to fall upon the man, and he slept; and he took one of his ribs, and closed up the flesh instead thereof, and the rib which Yahveh Elôhîm had taken from the man made he a woman, and brought her unto the man."

Such is the Hebrew form of the ancient Egyptian cosmogony. No one has yet attempted to reconcile *this* cosmogony with science. It has, of course, been reconciled over and over again with the later cosmogony set before it in Genesis, precisely as all other discrepancies have been reconciled, by the method which Bishop Butler contemptuously denounced. But with such reconciliations, purely theological in tone, we have nothing to do. They have no interest whatever for the scientific inquirer. As a mere matter of obvious fact, the two records are absolutely irreconcilable.

As M. Lenormant says: "No one has ever been able to explain how it is that man and animals are created by Yahveh in chapter ii. after having been created by Elohim in chapter i.; how it is that the name of Yahveh is said in Genesis iv. 26 to have been known to men ever since a period before the Deluge, when in Exodus vi. 3 it is said to have been unknown to the patriarchs; how it is that in Genesis vi. 5 it is Yahveh, and in verse 12 it is Elohim, who sees that the world is corrupt; and lastly, how it is that, while in Genesis vi. 13 Elohim orders Noah to make the ark, it is Yahveh in chapter vii. 1 who commands him to enter it; and how it is that in doing so Noah obeys Elohim according to verse 5, and Yahveh according to verse 9."

Of course all the peculiarities of the Book of Genesis, all the contradictions, and all those ideas which, in the presence of what is now known, appear crude and fantastic, are very easily understood when we recognise the diversity of the materials which Nehemiah and Ezra worked into the Pentateuch. Though previous high priests and scribes had manifestly been unwilling to regard as sacred all the documents which had been collected and were under their charge,

Nehemiah seems to have been unwilling to discard any of these documents absolutely. Antiquity doubtless gave them a sacred character in his eyes, which had been wanting when Hilkiah, for example, two centuries before, had gone through the collection. Hilkiah must have examined and rejected many of the documents which Nehemiah and Ezra accepted as sacred. But besides the old documents relating to early Jewish history and to Egyptian thought, Nehemiah had access to other materials of great antiquity unknown to Hilkiah. Among these may be included Babylonian records of various sorts, in which he seems so far to have placed trust that he thought it necessary to work them into the record of the earliest ages to which his collection of documents referred. So can we understand not only the diverse cosmogonies, but also the diverse accounts of the Flood in the early chapters of Genesis.

More perplexing perhaps are the contradictions, and especially the repetitions with changed names, in the accounts of patriarchal times. The story of a patriarch travelling with his wife and calling her, for his own safety's sake, his sister, must have been especially a favourite in the folk-lore of pre-Mosaic Semites; for not only is it told twice of Abraham and Sarah, with alterations of detail, but it is related also of Isaac and Rebecca, or of Yiçe'hâq and Ribqah, as our old friends appear in the newer translations.

A good feature in the volume before us is the separate appearance of the Elohistic and Jehovistic passages, as well as the usual form of the Book of Genesis with these accounts and others mixed up together. The quotations from the Targums of Onkelos, Jonathan ben Uzziel, and others, are also full of interest. The Targum of Onkelos is held to be of equal authority with the Mosaic text; and although some of the passages in it may appear, on account of their novelty, more surprising than those in the Book of Genesis as read in our churches, they could be quite as readily "reconciled" either with modern science or with other versions.

The introduction by the author of "Mankind, their Origin and Destiny," contains much interesting matter, not altogether well arranged—in fact, we fail to recognise any arrangement at all. The following extracts serve to show the view taken of the Jewish race, and of their fitness to teach the world religion. It is not altogether the view maintained by Mr. Matthew Arnold in "Literature and Dogma":—

"The Jewish conception of the Universe is that it was created expressly for them. . . . The seed of Abraham, 'the chosen ones' (Ps. cv. 6), were under the special care of Jahveh. 'As for the other people which also come of Adam, Thou hast said that they are nothing, but be like unto spittle' (cheerful for *nous autres*), 'and hast likened the abundance of them unto a drop that falleth from a vessel' (2 Esd. vi. 56). 'Anthropology,' says M. Burnouf, 'places the Semites between the Aryans and the yellow races. . . . While eminently superior to the yellow races, they manifest as regards ourselves differences which do not admit of their being classed with the Indo-European race. The true Semite has flat hair, in consequence of which the hair of his head presents a crisped appearance; his nose is extremely hooked, his lips are projecting and fleshy, his extremities are large, his calf small, and he is flat-footed. What is of more consequence is that he belongs to the occipital races—that is, to those races in which the posterior part of the head is more developed than the anterior or frontal portion. His growth is very rapid. At fifteen or sixteen years of age it has ceased. At the latter age the anterior portions of his skull, which contain the organs of intellect, are firmly brought together, and frequently even cemented to one another. The result is that there can be no further development of the brain, and especially none of the grey matter.' The Semites are unknown to history till a period between 3000 and 2000 B.C., when they gradually conquered the primitive and highly civilised populations of Babylonia."

It is strange to think how this people has conquered the average intellect of the Indo-European races—how widely they have caused to prevail their innate idea that "the universe was created expressly" for the Jews. Yet there is promise of freedom; the dawn of a clearer and purer day seems to have begun.

EVOLUTION OF LANGUAGE.

By Ada S. Ballin.

IV.—LOSSES AND GAINS IN LANGUAGE.

I SPOKE in my last of the various changes which the meanings of words may undergo in the course of time, and showed how the original meanings very frequently became obscured or forgotten. When the real meanings of words are unknown, and no reliable data are attainable as to their origin, the most plausible meanings that can be found are tacked on to them on the most flimsy pretexts. Prof. Sayce* has given an amusing instance of this. An old housekeeper, in a large mansion in the north of England, was in the habit of pointing out a Canaletto to visitors, with the remark that it was "a candle-light picture, so called because it could not be seen to best advantage during the day." Of like character may be the origin of many erroneous derivations as well as myths, and this tendency to make a meaning where none can be found has played its part in the development of language. For example, *pramanthus*, the name of the fire-machine anciently used in India, where two sticks were rubbed together, gave rise to the Greek myth of Prometheus, who stole fire from the gods. The Greek goddess Athênê takes her name from the Sanscrit *Ahanâ*, the dawn, of which a Vedic hymn says:—"Ahanâ comes near to every house, she who makes every day to be known." So that the origin of the Greek myth of the birth of Athênê from the head of Zeus is simply that the dawn springs from the face of the sky. Similarly Kronos, time, is said to devour his own children, the days and hours; similarly, also, the constellation which we know as the Bear got this name through a confusion in the Greek mind between *arktos*, from a root meaning to shine, and another *arktos*, from a root meaning to destroy, which signified *bear*. Hence the myth of Kalisto, who was changed by Zeus first into a *bear* and then into the star of that name. To return to modern times, Mount Pilatus, in Switzerland, the name of which literally means *cloud-capped*, has caused the Swiss to invent a story connecting it with the death of Pontius Pilate; and, to come from the sublime to the ridiculous, I may inform my readers that the *Colorado* is the *coloured* beetle, and has nothing to do with the place Colorado, whence it does not come. Ordinary persons would say that a walnut-tree was a tree so called because it is trained against a wall. Yet the word *wall* in this name has nothing to do with bricks and mortar, but simply means *foreign*: Danish, walnoot; Saxon, *walh*=foreign; German, wälsche nuss (Welsh nut), that is, foreign or Celtic nut. An itinerant vendor of vegetables, if asked why asparagus was so called, would probably say: "Sparrergrass is sparrergrass cos the sparrers eat that kind o' grass." In old cookery-books, and in some counties, "grass" or "gress" is the market-gardener's name for

* "Introduction to the Science of Language," Vol. I. p. 244.

asparagus. The old English word was *sperage*, probably from the Greek *speira*, a spire, owing to its long, narrow form. About 1600, the classical form asparagus was brought into use, and within fifty years after that time the word had been corrupted to *sparagrass* and *sparrowgrass*, which form prevailed so far that Walker, in 1791, remarked: "*Sparrowgrass* is so general that *asparagus* has an air of stiffness and pedantry."

Not only, however, may words, as I have shown, change so much both in form and in meaning as to be unrecognisable except to the trained eye or ear, but they may also drop out of use altogether, or be retained only in special senses, as, for example, many are existent in jurisprudence which were once words in general use. Thus, to take a few examples at random: *Forthright* was used by Sidney to mean "in a straight direction;" *forthy* (Saxon *forthi*), meaning *therefore*, by Spenser; to *bemete* with Shakespeare meant to measure; *cest* (Latin *cestus*) was used by Collins for a lady's girdle; *mure* (French *murer*) to enclose in walls, wall up, is now only known in the form of the verb to immure; the word *pelt*, skin of a beast (German *pelz*, Spanish *pelada*, Latin *pellis*, used also in the form *fell*, as *wool-fell*, &c.), is known only to those engaged in the fur or leather trades. Words fall into disuse through the loss of the ideas they express: as, for example, numbers of words in use in chivalry, which, if they survive at all, do so only in the old-world science of heraldry; words common in the feudal state, now no longer required; or those employed in now-exploded theories of science. Words are also supplanted by others expressing the same ideas but of different origin. This latter cause of change in language is mainly brought about by intercourse of different peoples. Where nations, or even small communities, live shut out from the rest of the world, their languages or dialects remain unchanged proportionately to the degree of their isolation. Among the French-Canadians words are now in use which are quite obsolete in France; and the same phenomenon is observed in the English of New Englanders, for, writing about forty years ago, Mr. James Russell Lowell remarked that the dialect of Massachusetts contained many words "noted in English vocabularies as archaic, the greater part of which were in common use about the time of King James' translation of the Bible." "Shakespeare," he said, "stands less in need of a glossary to most New Englanders than to many a native of the old country." Those cut off from immediate intercourse with the Mother-country are of necessity unacquainted with the changes which have taken place in the mother-tongue, and although their own language will not have remained stationary, its changes will have been peculiar to itself.

Besides the loss of whole words, grammatical forms and distinctions tend to become obsolete. Thus English has lost the case-endings possessed by its ancestors, and the same is true of the personal endings of verbs. A similar tendency to do away with forms which are redundant or not absolutely necessary for the expression of thought exists in a more or less degree in all languages. The Semitic noun originally possessed three cases—nominative, genitive, and accusative, but these gradually died off in some of its branches, as in Hebrew,* and symptoms of the similar decay of case-endings are very apparent in modern Arabic, as compared with the literary language. The reason for this decay is obvious. Language is an instrument for the expression of thought, and, in order to be perfectly adapted to its use, it should express the thought in the clearest and briefest way possible, and its parts should tend to uniformity of structure. Hence case-endings and other grammatical forms are dropped, the context being usually sufficient to indicate the relations of the various words in a sentence, or their place is taken by particles, such as *to*, *for*, *with*, *by*, &c., which are applicable in all instances without further change. Finnish has fifteen cases, and Hungarian more than twenty, but this does not constitute them the better instruments for expressing thought. The complications of case-endings, such as are seen to the full in German, are not only unnecessary but cumbrous to the memory, and may, in fact, be regarded as barbarous. There is little doubt that they will eventually disappear, but probably not in our time. I have briefly referred to the losses of words and grammatical forms, but, although it may seem paradoxical to say so, these losses are in reality gains. They are a part of the natural development of language, which tends to integration, unity, and simplicity.

The introduction of new words and forms into language is always going on, and their origin is sometimes purely accidental. A good example of the accidental origin of a word is that of *schooner*. The first vessel of this sort was built at Massachusetts, and, when launched, a bystander, admiring her graceful movement, exclaimed, "Oh, how she scoons." "A *scooner* let her be, then," said the builder, and coined a new English word.

The word *furbelow*, now commonly used to express a fussy arrangement of ladies' drapery, is one which was originally spontaneously coined out of relation to other words. It is first found in De Caillères, and, according to Nodier, was invented by Marshal de Langlée, who, passing a milliner's shop, determined to puzzle the assistant, and, entering, asked for a *falbala*. The fitness of the word was, however, instantly acknowledged, and the girl brought him the dress which was at that time called *volant*, because of its light, floating points. Other such words are *od* or *odic* force, invented by Reichenbach, and *sepal*, invented by Necker to express a division of the calyx of flowers. Pierre Rivière, the murderer, invented the words *ennepharer*, to express a certain form of torture to which when a boy he used to subject frogs, and *calibène* for the instrument he employed to kill birds. These words have not survived, and their unfitness is very apparent. A curious word, which seems to me unconnected with any other, is largely used in my own family, both in the form of verb and noun. The word is *thoke*, in the sense of to lie in bed late in the morning. One of us will commonly say to the others, "I'm going to thoke to-morrow morning," as an indication that early breakfast is not required, or, "I had a good thoke this morning," meaning "I got up late for a treat." The word is a very useful one, as it embodies an idea which would otherwise have to be expressed in a number of different words—the idea of staying in bed late for a treat. It was introduced into the family about ten years ago, from a book which I believe was called "The Winchester Boys," and in which it is used in the same sense in which we employ it; but I am unable to say whether it originated with the author of that book. To indicate how dialectic variations may arise, I may add that my brothers-in-law pronounce the word *thoke*, which they have picked up from their wives, as *soak*, and maintain that this is correct, by a false derivation connecting it with the verb "to soak," meaning "to immerse."

With regard to the origin of most new words, it may be said that an idea is present in the mind which desires to communicate it, and certain materials already in existence are generally seized upon and combined to serve the purpose of communication. The word *gas*, connected with *geist*, *ghost*, and *yeast*, was invented by Van Helmont, the great chemist, about 1600 A.D., to express a chemical discovery of

* See "A Hebrew Grammar with Exercises," by Ada S. and F. L. Ballin, page 22 (Kegan Paul, Trench, & Co.).

his own. Two or more familiar syllables or words may be united for the same purpose, as *railway*; or old words may be newly applied, as *revolver*, a pistol that has a revolving part. A word thus originated in the mind of the individual, its survival depends upon its utility and fitness, and, once generally adopted, it may ultimately become the parent of many others, and its range of meaning may be indefinitely widened. Whitney says that if every meaning attached to a word were to count as a separate word, the hundred thousand words of which the English language is formed would doubtless be increased to a million or two; while the Rev. T. Hurlbut has made the stupendous calculation that seventeen million verbal forms may be made from one Algonquin root.

In the complicated languages of civilisation, however, it is doubtful whether any one individual ever acquires the whole language—that is to say, knows every word of it. Each adopts that part of it which suits his own purpose. The English language consists of about ninety or a hundred thousand words. Out of these Shakespeare uses about 15,000; Milton, 8,000; a person of ordinary culture, 3,000 or 4,000; and an agricultural labourer possibly not more than 300; while a journalist accustomed to deal with many subjects would probably reach 13,000 or 14,000.

Charles Reade describes the daughter of a small shopkeeper in Liverpool as having "plenty of tongue and mother-wit, but she could not, and would not, study anything if it had the misfortune to be written or printed."* Further on,† he says, "Her whole vocabulary was about nine hundred words, whereas you and I know ten thousand and more; yet she would ring a triple bob-major on that small vocabulary, and talk learned us to a standstill." Volubility does not necessarily imply a large command of words; while, on the other hand, we have all heard of the great man who was silent in fourteen languages.

Each language meets the average necessities of its speakers. A small mind can only grasp a small part of it; but a large mind will often find it too small for its requirements, and will have to seek among other tongues the means of expressing its thoughts. An African above the level of his race would be fettered by the language to which he was born; but English would open up a wide range of ideas to him, and raise him infinitely higher than he could rise without some such means of marking and signifying his thoughts. A language expands and contracts in adaptation to the needs and circumstances of those who use it, and it is enriched or impoverished with the minds of its speakers. Conversely, an Englishman forced to express his ideas in some African dialect would be wholly at a loss, for where the ideas have never been the words cannot be found. Similarly, every language possesses some words, phrases, or, as they are called, idioms, which cannot be exactly translated into another tongue; every nation has some peculiar modes of thought, and thus it is that the intellect is widened by the acquisition of foreign tongues.

Words are learnt by children much on the same principle as they are adopted by communities. Among the hundreds of words that a child hears every day, it picks up, as we may say, those which apply to its own few and limited ideas, leaving all others. Of course imitation plays a large part in the acquirement of speech by children; but if by imitation a word is taught to a child which it cannot apply to any thought, it is soon forgotten and not really adopted into the little one's language. As new ideas are taken into the mind or grow up in it, new words and combinations of words are adopted to express them. In the race new ideas are acquired but slowly, and the means of expressing them are, therefore, but of tardy growth; but the child is constantly under the tuition of older individuals who have acquired a great part of the sum of thought and language developed in the race, and thus it is that each child acquires in the course of a few years the total results of a culture which its ancestors have taken countless centuries of development to gain. This acquisition is limited only by the individual capacities of the child; but if these capacities are great he may himself leave behind him some idea and some word which shall find a place in the culture of his race. Thus it is that the processes of civilisation, and among them language, are evolved. To each child, with words, are taught also distinctions, classifications, abstractions, and relations; while by their means attention is directed to matters which call for observation, the senses are roused into fuller consciousness of perception, and the reasoning powers are trained.

The position has been clearly defined by Whitney, who says, "Language enables each generation to lay up securely, and to hand over to its successors, its own collected wisdom, its stores of experience, deduction, and invention, so that each starts from the point which its predecessor had reached, and every individual commences his career heir to the gathered wealth of an immeasurable past."

* "Singleheart and Doubleface," p. 1. † Id. p. 2.

MIND ACTING ON BODY.

By Richard A. Proctor.

BUT, striking as are the cases thus far considered, which relate to disorders of a kind which have been known in many cases to yield to the action of the imagination, the reader may be more struck probably by cases in which the actual progress of internal organic diseases would seem to have been arrested by psychical means. Some thirty years ago Sir John Forbes mentioned some remarkable instances of this kind, which had been described in a very interesting paper communicated to the *British and Foreign Naval Review* by a naval surgeon whose high character was well known to him. Most of these cases are not such as could be advantageously described in full in these pages. The following account, one of the most striking, has been abridged and verbally modified (not at all altered in essentials) to render it more suitable for my readers. In July 1845 the company of a Government ship were attacked by an epidemic complaint, which in several instances led to a severe form of dysentery. Among those who suffered most was a first-class petty officer, who, though he had had but a mild attack of dysentery, had been much distressed by some of the sequels of the disorder. To remove these, very powerful medicines had been employed, and successfully, save in this respect—that intense irritation of the stomach had been produced, from which the patient suffered severely. External irritants were employed until the poor fellow's skin became perfectly callous; sedatives were given until his senses were muddled; but he seemed to obtain not the least relief. "This being so," says the writer, "I determined to try the effect of mental influence: stating to him, as I did to the other men, that as his disease was most obstinate, so was it necessary to have recourse to desperate means to relieve it; that with his sanction I would therefore put him under a medicine which it was necessary to watch with the greatest attention lest its effects should prove most prejudicial, perhaps fatal, and so forth. Having by these statements

made an impression, it became necessary to keep it up. This was done by repeated visits, at all hours of the day and night, and by expressing on these occasions the most intense anxiety as to the effect of the very powerful and dangerous medicaments. This was not a case in which a sudden effect could be expected to be produced, whatever might be the means employed. Symptoms of disease existed which bore too close a resemblance to those of an organic order to admit of hope of a sudden, if even of tardy, relief." (It will be seen presently that unmistakable evidence was afterwards obtained of the existence of such organic mischief as the surgeon at this time feared.) "Hence the pills (*bread*, of course) were given every sixth hour only. Within twenty-four hours the man's sufferings were decidedly less. Within four days he was almost free from pain. On the sixth day he was quite so; his pills were omitted; and at the end of a fortnight he was again at duty with a clear eye, a healthy skin, and was rapidly regaining his flesh. Here, as in most cases where this method has been tried, the diet and drink have been left unrestricted. Occasionally, however, it became necessary to taboo some article, lest its coming in contact with the remedy might prove most destructive; in other words, articles were occasionally forbidden when the mind seemed to be inclined to lose sight of what must be made the all-important subject of thought by night and day. The wonderful improvement in this man's state was frequently commented on by both officers and men, who of course were, and still are, as little acquainted with the means employed as the patient himself was."

This case is so remarkable that we might well be disposed to consider that the man's cure was not in reality affected by the means to which the surgeon attributed it. Might not the illness, for instance, have been on the point of yielding to the remedies used before the mental method was tried? Or may there not have been some other cause at work? for to mention no other, a patient on board ship may have changes of climate unlike those ordinarily experienced by the patient on land. One feels disposed at a first view of the case to prefer an explanation based on the possibility of some such causes as these having acted, than one which in reality requires us to believe that a man (and one too, be it remembered, not specially trained, like some Eastern devotees, to fix his attention constantly on his interior), by thinking constantly about the good effects of a supposed medicine upon his stomach and intestines, could actually cause organic changes to take place in these viscera. The case would then be a singular introversion of the state of things described by Macbeth. He says, "Canst thou not minister to a mind diseased?" But here the physician throws his physic on one side, not because he cannot minister to a mind diseased, but because he believes a healthy mind has the power of ministering to a diseased body when physic has altogether failed. The memory (of bread pills and of their imagined potency) was here trusted to pluck from the intestines a rooted trouble, the brain was called upon to raze out the written troubles of the stomach. For it appeared afterwards that these troubles *were* written (at least, in the poetic sense in which Shakespeare uses the word). They had, at any rate, made their mark. Let the rest of the story be carefully noted. "It may be said," proceeds the narrator, "that this case, as above given, goes for nothing, in so far as it does not show that the pains were anything but casual; in which case any mode of treatment, or very likely no mode at all" (doubtless the reader has already thought of the possibility that the medicines made most of the mischief), "would have been equally successful; or it may be again, as it has before been said, that it" (the disease presumably) "was altogether feigned, and that the commanding officer would have made a better and quicker cure. I think not; and for the following reasons: the man's flesh had wasted; his eye became sunken; his skin sickly in hue, as well as in feeling; his sleep, when he had any, was of the most disturbed character. But more than all, the pain after some weeks returned, and the other bad symptoms followed in its wake; *yet both it and they were relieved a second time by the same means.* While suffering from a third attack he was sent to the Royal Naval Hospital at Malta, and there, after much suffering, he brought up by vomiting a portion of the mucous membrane of one of the small intestines" . . . clearly recognisable by a well-trained medical eye. "I am distinctly assured," says our author, "by one of the officers of the establishment, that he most carefully examined the ejected matter, and that its characters were so marked that there could be no room for a doubt as to what it was. This being so, we have pretty clear proof that disease existed long before this slough was thrown off; and that even this organic disease was suspended, on two occasions, by mental influence only."

The question how far it is a legitimate medical practice to deceive a patient in such a case as the above has been raised by Dr. Todd, and is answered by him in a way which seems open to objection. "Nothing," he says, "can justify our asserting what is not true in order to gain the patient's confidence." And elsewhere, "in regard to misleading patients generally, even *causâ scientiæ*, one of the practical difficulties the investigation into the influence of the imagination presents is certainly the unseemliness of making experiments of this nature, and the danger of sullying that strict honour which by no profession is more prized or maintained than by the professors of the medical art." If the cause were that of science alone, this emphatic opposition to the misleading of a patient might be regarded as justified. But there certainly seems an excess of strictness in objecting to the deception of a patient for his own good. If a doctor is perfectly satisfied that a patient will not recover without a strong mental effort, and that this effort will certainly not be made unless the patient is misled with regard to the nature of the treatment, the doctor might fairly consider it his duty to "assert what is not true to gain the patient's confidence." An adherence to veracity so scrupulous as to outweigh the life of a fellow-creature may appear deserving of admiration when dealt with in a treatise on morals, but in actual life would be altogether objectionable. If it be urged that liberty to deviate in some such cases from strict truth might be open to abuse, it may at once be answered that so also would liberty to select the strictly veracious course (under any circumstances) be open to abuse. Consider, for instance, the following case, which is by no means an imaginary one. A man is lying prostrate under a very dangerous illness, and it is known to all who attend on him that any severe mental shock must inevitably prove fatal to him, but that if for a few days he can be kept free from mental disturbance he will recover. He sends a messenger to inquire about the health of a beloved relative, whom he knows to be in a critical condition, or exposed perhaps to some special form of danger distinct from illness. The messenger, when he reaches that relative's house, is informed that death has been there before him. Shall he return and tell the patient the truth, thereby certainly killing him? Let it be assumed that he must at any rate take some message back; protracted anxiety being, let us suppose, as dangerous for the patient as the sudden shock of illness. He can do only one of two things: tell the truth and kill, or assert what is not true and spare the patient's life. Few will question what he ought to do. But the question may be raised, is he to be regarded even as free to choose? He holds for the time being the patient's life in his hands; he

can kill or spare; if he kills, how should he escape reprobation? And might he not be so situated that liberty to choose one or other course might be abused if he told the truth? His fatal veracity might not be the offspring of a tender conscience, but of greed or some other evil passion. The doctor in the cases considered by Todd is somewhat similarly circumstanced. He is satisfied that there is a chance, at any rate, of saving life, if his patient is assured that certain substances are medicines potent to cure. Is he justified in refusing to his patient this chance of life? Doctors might unquestionably use for a wrong purpose the right of misleading a patient for his good; but they might use for a worse purpose the right (if they possessed it) of killing him with the blunt truth.

A singular case, bearing in some degree on the right to mislead a patient, was described a few months ago in a public address by a well-known American doctor. A young lady in one of the Western States was convinced that a bristle of her tooth-brush had become imbedded in her throat, and was causing mischief there, which would terminate fatally if the foreign body were not removed. The family doctor, and after him several physicians of repute, examined her throat, and all agreed in assuring her (which really was the case) that there was no bristle there at all. She continued to grow worse, the imaginary bristle causing all the effects which a real bristle might perhaps have caused—at any rate, all the effects which she imagined that a real bristle would cause. At last a young surgeon was consulted, who followed a different line of treatment. Looking long and carefully at her throat, and examining the afflicted part with several instruments, he at last gravely assured her that she was quite right; a bristle was there, and the inflammation she experienced was undoubtedly due to it. He could not, he said, remove the bristle at once, as the only instrument which would effectually reach it was at home. He went home for it, as he said, but really to inclose in an instrument of suitable form a bristle from a tooth-brush. Returning, he carefully nipped the skin of the throat where the young lady felt the pricking of the non-existent bristle, and, after causing her enough discomfort to satisfy her that this time the operation of extracting the bristle was certainly in progress, he withdrew the instrument in triumph, and along with it the bristle, which had indeed first entered her mouth in that instrument's company. From that time she recovered rapidly. For it will be understood that, though there was no real cause for her fears, a real irritation had been excited by them, and organic mischief had resulted. The story ends here so far as our present subject is concerned, though as a tale it may seem to many incomplete without a few words more. The young surgeon, we are told, was highly in favour thenceforth. He had not only saved her life, as she supposed, but had shown her to have been right, and all her friends, as well as the other doctors, wrong. She would have accepted his hand but for the circumstance that, having already a wife, he omitted to offer it. She blazoned abroad his fame, however, until he had become famous "throughout the whole State." All would have ended pleasantly had he not in a moment of weakness confided the true explanation of the young lady's cure to his wife—of course, under promise of strict secresy—which, however, did not prevent the story from reaching the young lady's ears in a few hours. It is hardly necessary to say that thenceforth her feelings towards the doctor were the reverse of those she had entertained before. True, she owed her cure to him, but the cure was worse than the illness.

In the case last considered, which, be it remembered, actually occurred, though probably some of the surroundings were a little altered by the narrator, the truth, supported though it was by the weight of authority, not of one doctor only, but of several, was found ineffective to arouse the will of the patient even against a disease which had had its origin in her imagination only. We may well doubt then whether, if the influence of the mind on bodily processes were thoroughly recognised and admitted, it will be found possible to produce the same effect by a direct and truthful appeal to the will as by misleading the patient. That some few persons of strong will could by a resolute effort check the progress of actual disease in their internal organs, or excite processes of organic change resulting in cure, may be admitted,* but it must at the same time be admitted that in the large majority of cases this would not happen, even if the patient could be persuaded to make the attempt. It is only when unconscious of control that the ordinary mind is capable of directing the attention fixedly in the way required. And of course, in the great majority of cases, the doctor has to deal with men of ordinary mind, not with those possessing strong power of fixing the attention, and resolute will to exert that power.

(*To be continued.*)

INTRODUCTORY STUDIES IN GREEK ART.†

MISS HARRISON'S new book is one which may be read with interest by many classes of readers. It is a useful addition to the library of the art student, and it throws a light on art matters which the general reader will be glad to find. The authoress is no superficial dabbler, nor does she lose herself in dry technicalities, but she endeavours to explore the causes and motives of artistic developments, and to grasp the spirit while not neglecting the letter. Thus she shows the influence exercised on the Greeks by the art of Egypt, Assyria, and Phœnicia, and deals with the early artists in a masterly fashion. She points out how the apparent monotony and conventionality of Egyptian art mainly arose from the conservative character of the people, as influenced by the physical peculiarities of their country, by the despotism of their kings, who, in the longing for immortality and the love of self-glorification, commanded the vast size of their monuments, and by the hard material employed for the sake of durability by a preference characteristic of the Egyptians, who preserved their mummies in the belief that the soul would in some far distant time return to its disused body. The want of ideality in Egyptian statues may be traced to the fact that they were not primarily intended as *objets d'art*, but were actual representations of the individual rendered as lifelike as possible, so that, if when the soul returned it should find its mummy in an imperfect condition, it should take up its abode in the statue, and to this end they were buried with the mummy to lie hidden from the world until discovered by the pick

* I offer the following experience with some diffidence, because the effects supposed to have resulted from an effort of the mind may be otherwise explained—possibly were due to mere coincidence. Still, such effects have been noticed in so many cases, that I am disposed to explain them in the way suggested. It has frequently happened to me that during a busy week, fortnight, or month of lecturing I have noticed signs of an incipient cold—such signs as under ordinary conditions have been nearly always followed by a severe cold with loss of voice. Now I have observed that in the majority of instances of this kind no such sequel has followed, although no greater care has been taken to check the progress of the cold than at other times. It is as though the strong feeling that I *must* not take cold prevented me from doing so.

† "Introductory Studies in Greek Art." By J. E. Harrison. T. Fisher Unwin, London. 1885.

of the workman or explorer. By Egyptian belief the dead man became a part of the god Osiris, and thus by a natural transition the funeral chapel became the temple. In this may be found the explanation of the fact that, while temples dedicated to a god alone are found on the east bank of the Nile, on the west, where funeral chapels would naturally be built near the City of the Dead, these exist in temple form in honour of a king and god conjointly. Such is the temple of Seti at Abydos in honour of six gods and of Seti himself. On Egyptian, as well as Assyrian and Phœnician art, picture-writing had a very great influence. In the hidden recesses of the Egyptian tomb are painted and sculptured the history of the dead man's deeds in life, the story of the soul's wanderings and transformations after death. On bas-reliefs, on the stone copies of the robes of Assyrian monarchs, on Phœnician bowls are sculptured the adventures of kings, the myths of the gods, and metaphorical representations of the nation's power and history. The Phœnician colonies spread over the Mediterranean Sea, and the treasures of Eastern art brought by these enterprising traders aroused the rude artists of Greece to rivalry. The metope of Selinus' temple, now in the Palermo Museum, the subject of which is the slaying of Medusa by Perseus, is a specimen of the childhood of Greek art. It shows traces of colouring, and the clear influence of the East. (See fig. 6, p. 157.) With the Greeks, however, the human form was looked upon as the perfection of beauty. Among their predecessors the form was nothing, attention being given only to the face and the drapery. The first Greek gods were heroes, and just as the gods were idealised men, endowed with human emotions, so they were represented in human form with the bodies of men and women rendered as perfect as study and the selection of the most perfect models could make them. Miss Harrison sketches the progress and decay of art in Greece, from its rise to its fall, under the influence of Rome; but in this branch of her work space forbids our following her. Her book is not only instructive, but very pleasant reading, since her style is easy, forcible, and entirely devoid of pedantry. The book is beautifully illustrated with photographs reproduced by the Meisenbach process, which greatly enhance its value.

THE SIDEREAL SYSTEM FATHOMLESS.*

By Richard A. Proctor.

It is commonly supposed that Sir W. Herschel's plan of star-gauging demonstrated that the sidereal system has limits to which his gauging telescopes penetrated (save in a few directions), and that even where the system has its widest extent its limits are certainly attainable by such telescopes as men may well hope to construct. I would invite attention to certain evidence pointing to a very different conclusion.

It is perfectly clear that if the sidereal system have the figure hypothetically assigned to it by Sir W. Herschel, that of a lens shaped stratum throughout which stars are distributed with tolerable uniformity, then we must accept the evidence adduced by him as sufficient to prove that we can attain to the limits of this stratum. To use the words of Professor Nichol: "When an eye is directed towards a prolonged bed of stars, there is no reason to fancy that it has reached the termination of that stratum, so long as there appears behind the luminaries, which are individually seen, any milky or nebulous light, such light probably arising always from the blended rays of remoter masses. But if, after struggling long with a nebulous ground, we obtain a telescope that gives us additional light with *a perfectly black sky*, we then have every reason the circumstances can furnish on behalf of the supposition that at length we have pierced through the stratum—a probability, indeed, which can be converted into certainty in only one way, viz., when no increase of orbs follows the application of a still larger instrument." Sir John Herschel also says that in those regions where the zone is clearly resolved into stars well separated and seen projected on a black ground, it is *certain* if the ordinarily accepted theory be correct, that we look out beyond into space.

But this conclusion would no longer follow as a necessary consequence of such observations if, instead of regarding the sidereal system as of the figure and structure suggested by Sir W. Herschel, we supposed it to consist of clustering aggregations (including *streams* under that expression) of stars of every variety of magnitude. Then, in struggling with a nebulous ground, we should not be penetrating farther and farther into the celestial depths, but should be simply analysing more and more searchingly a definite aggregation of stars.

Let us consider a noteworthy instance, interesting not only because it illustrates the mistakes which might arise from falsely assuming a certain uniformity in stellar aggregation, but because it shows how a thoughtful astronomer like Sir W. Herschel would instinctively recognise, under such circumstances, the fact that he was going astray, and would be capable of quietly relinquishing views on which he had before laid considerable stress.

In the constellation Perseus there is a magnificent double cluster, visible to the naked eye on tolerably clear nights, and presenting, even in small telescopes, a scene which forces sensations of awe and reverence upon the least thoughtful mind. With a large telescope the spot "appears lighted up," says Nichol, "with unnumbered orbs, and these pass on and on, through the depths of the infinite, until even to that penetrating glance they escape all scrutiny, withdrawing into regions unvisited by its power. But shall we adventure into these deeper retirements? Then assume an instrument of higher efficacy, and lo! the change is only repeated; the nearer stars now shine more brilliantly; those scarce observed before appear as large orbs; and behind, a new series begins, again shading gradually away, leading towards further mysteries! The illustrious Herschel penetrated, on one occasion, into this spot, until he found himself among depths whose light could not have reached him in much less than four thousand years. No marvel that he withdrew from the pursuit, conceiving that such abysses must be endless!"

But this conclusion, that the light from the furthermost parts of the cluster occupy some forty centuries in reaching us, while the light from the larger stars in the cluster, according to the usual estimate of star magnitudes, would occupy but one or two centuries, brought with it perplexities which Sir W. Herschel was too clear-sighted not to recognise. It required that the real shape of the cluster should be somewhat as is shown in the accompanying figure, in which S is the sun, and S B is some twenty times as great as S A. On no other supposition could the peculiarities of the cluster be explained, so long as it was understood that a general uniformity of magnitude and distribution prevails among the component stars.

Sir W. Herschel was thus led to recognise the cluster as including within its bounds stars varying greatly in real magnitude. Nay, he pronounced the opinion that we have in this cluster a sort of nodule of the Milky Way—a dis-

* This paper, like that on the Figure of the Milky Way, was written when I was in correspondence with Sir John Herschel about the architecture of the Heavens.

tinct clustering aggregation of stars within the limits of the galaxy.

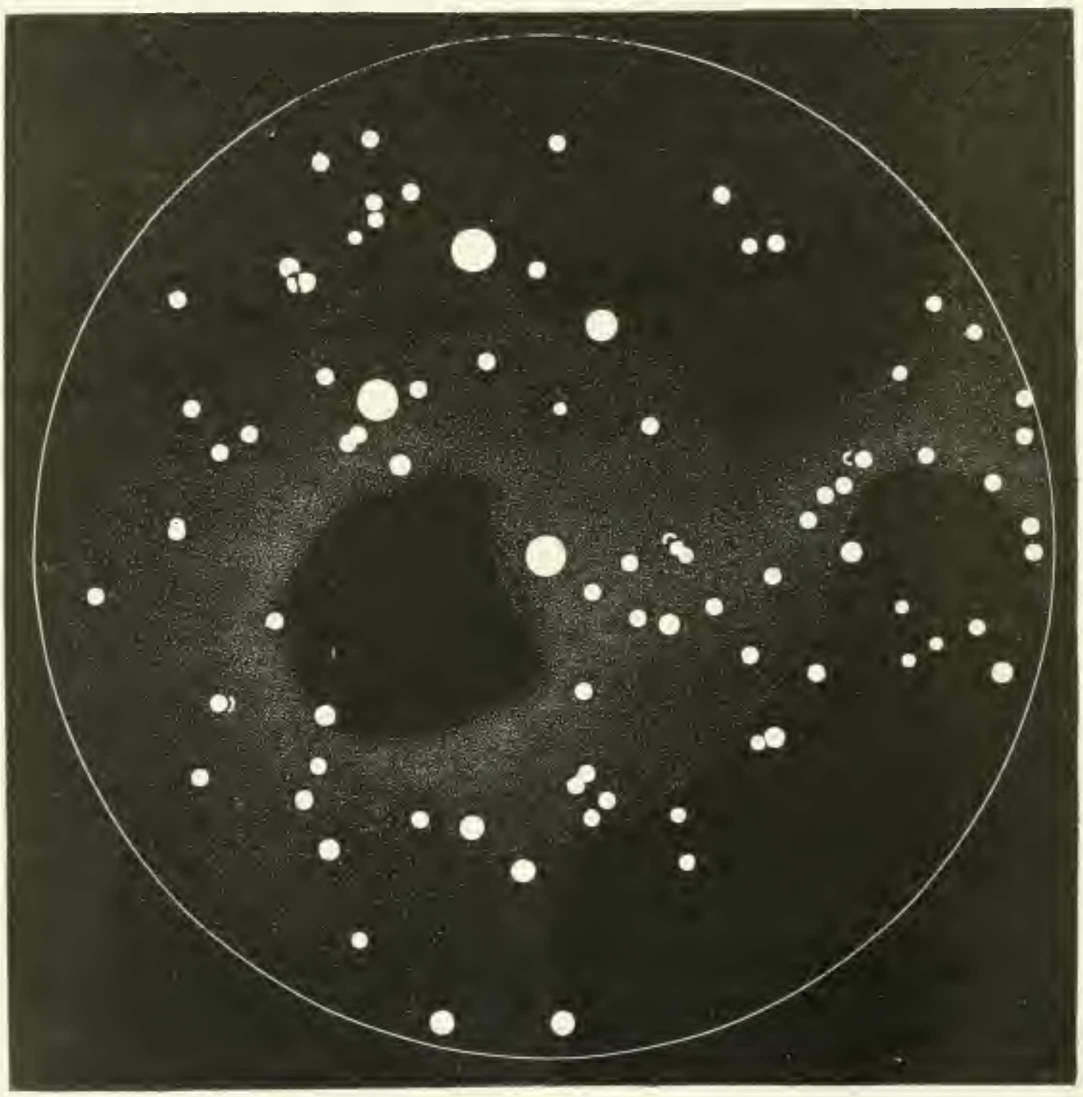
Now let us consider what such a change of view meant. Instead of supposing that each increase of telescopic power had enabled the observer to pierce farther and farther into the sidereal depths in this direction, Sir W. Herschel now saw that all the successive investigations had dealt with the

Are we quite sure that a similar error does not affect the whole system of star-gauging, or rather the fundamental principle on which that system is established? What real evidence have we that, when we are poring more and more searchingly into the recesses of the great star-girdle, we are passing ever to distances farther and farther from the sphere of the lucid stars?

Fig. 1.

Frustum of a Cone, enveloping the Great Cluster.

Fig. 2.



The Coalsack in Crux.

same region of space. The difference was as great as though an astronomer, discovering new asteroids and conceiving their minuteness to be due to distance, so that they all lay hundreds of times farther off than Jupiter, suddenly learned their true nature and that all his researches had dealt with a zone far within the orbit of the giant planet.

It seems to me that, before accepting the results which have been supposed to flow from the star-gaugings, we are bound to inquire somewhat more closely than has yet been done into the question whether the probabilities are in favour of that general uniformity of distribution and magnitude on which the plan was based.

And here an important point presents itself to our consideration. *Admitting* this fundamental hypothesis, it is very obvious that we must pay no attention to the signs of special laws of association among the lucid stars. These stars are altogether dissociated from each other in reality, however they may seem associated—if only that hypothesis is correct. But when we are inquiring *whether* that hypothesis is correct, these signs of association are all-important for our guidance. We are bound to inquire whether they *can* be accidental. And so we are no longer free to smooth the star-groupings away by taking averages.

This bears in a very important manner on the problem presented by the Milky Way. Sir John Herschel, following very accurately the law of star-gauging, compares the total number of lucid stars on the galactic zone with the total number on the rest of the sky, and finds no trace of any aggregation in the former region. Hence he concludes (very justly, when once the fundamental law is accepted) that there is no real association between the lucid and the telescopic stars on the galactic zone.*

But suppose that instead of considering the galactic zone, instead of spreading the galaxy over a belt which it does not really cover, we look at the galaxy itself. And suppose, further, that as a first process of examination we compare the number of lucid stars falling on the galaxy with the number falling on the dark rifts and coal-sacks in the Milky Way, and on the space which separates the two branches where the galaxy is double. Doing this, we find at once the most striking evidence that the lucid stars are closely associated with the telescopic galactic stars; for we find a marked disproportion between the number of stars on the dark regions and the area covered by these regions. In many places, especially in the southern heavens, we find the very shape of the Milky Way indicated by the stars which lie round the border of the dark regions, but withdraw themselves, so to speak, from those vast openings into space.

Take as an illustration the coal-sack in Crux. Is it an accident that over this large dark space, covering about 50 square degrees, there is not a single lucid star, while all round its borders lucid stars are strewn in plenty? The whole surface of the heavens exceeds the coal-sack some eight hundred times in extent; and as there are about 6,000 lucid stars, one might expect seven or eight such stars to be found in the coal-sack. But this is far from being all. The neighbourhood of the coal-sack is much richer in lucid stars than other regions in the heavens; so that it is just where stars should be most richly distributed that this vast black spot makes its appearance. The question whether the absence of stars from the coal-sack and their presence in great abundance in the Milky Way around that vicinity are to be regarded as a mere coincidence can scarcely be doubtful, I think, to anyone who studies thoughtfully the portion of the galaxy depicted in fig. 2. Nor, perhaps, is the way in which the sharply-defined semicircular cavity on the right is associated with a semicircular stream of stars less significant. No one who examines this region thoughtfully can doubt, I should imagine, that the lucid stars seen in it are mixed up with the telescopic stars forming the Milky Way here.

But if we admit that such evidence as this (and much more of the same kind might be adduced did space permit) should lead us to regard the Milky Way as forming a stream of really small stars, swayed into its present figure by the large ones in its neighbourhood, it might seem that, so far from showing that our sidereal system has no limits, we should have gone far to prove that its dimensions are much smaller than had been imagined.

It is true that, according to these views, the small stars in the Milky Way would be far nearer to us than has been commonly supposed. But on the other hand, it would follow with equal certainty that we could no longer imagine we had even in any one direction pierced to the limits of the sidereal system. If in searching into the depths of any part of the Milky Way we are, in truth, merely searching more and more closely within a definite group of stars, beyond that group there may lie at enormous distances other groups which no telescope we can construct may even render visible. It was only, indeed, whilst it was thought that the sidereal system is continuous throughout its limits that astronomers could hope to say where those limits lie. If, on the contrary, I am right in believing that the sidereal system consists of aggregations of every conceivable form, those aggregations may extend into space, millions on millions of times beyond the limits of the most powerful instruments man may ever be able to construct.

* In his "Outlines of Astronomy" he uses expressions which would seem to indicate that he had forgotten the facts very clearly established and described on pages 381 and 383 of his observations made at the Cape of Good Hope. Nor can one wonder at this when one considers the wonderful range and extent of the observations recorded in that most valuable treatise, second only (if second) in value to the series of papers by his father in the Philosophical Transactions of the Royal Society.

New Books to be Read (or avoided)—and Why.

Kalee's Shrine, by Grant Allen. Mr. Grant Allen's new story is a vigorous example of the "scientific use of the imagination;" the license of fiction is nowhere restrained, but the accurate description which comes of insight into, and sympathy with, nature's least garish scenes, is not lacking. The tale opens weirdly enough in the scorching jungles of India, but is speedily transferred to a humdrum watering place of old-fashioned type on the breezy flats of East Anglia. The incidents are numerous and original enough, however, to make the dry bones of the old town live again; and we can promise our readers an honest shillingworth's excitement, not without safety-valve in the sequel. Mr. Allen has, in more than one of his delightful fugitive sketches, laid stress on the unsuspected beauty in mud, and in "Kalee's Shrine" that unstable compound is made the scene of an episode which, for inducing an "eerie" sensation in the reading, has not been excelled, if equalled, in any of the now famous series in which the story is published. We must not risk spoiling the reader's interest by telling it.

Handbook of Mosses. By James E. Bagnall, A.L.S (London: Swan Sonnenschein, Le Bas, & Lowrey. 1886.)—The country reader who wishes for an introduction to a living world of strange beauty and variety, as well as the incipient student of bryology, may buy Mr. Bagnall's well-written and equally well illustrated little volume with the certainty of finding what he wants within its two covers. Its author describes the few and simple appliances needed for the collection and examination of these exquisite lowly forms of vegetation; describes their development, instructs us how, when, and where to find them; gives a classification of the British species extensively illustrated; furnishes directions for their cultivation; and winds up with a chapter on their preparation for the cabinet and herbarium. His work is well and honestly done throughout.

Rudiments of Chemistry. By Temple Orme. (London: Swan Sonnenschein, Le Bas, & Lowrey. 1886.)—This little book consists in effect of the description of a series of easy and attractive experiments, by the aid of which the rudimentary principles of chemistry may be explained and illustrated with facility. It is absolutely elementary, all use of the atomic theory being eschewed, and the consequent familiar equations being wholly absent from its pages. A large proportion of the experiments described may well be performed by any intelligent boy himself, and, apart from its undoubted use and value as a school manual, we cannot help thinking that it would form a very welcome and amusing present to any such lad with the slightest taste for scientific pursuits.

Mind your Eyes! Advice to the short-sighted, by their fellow-sufferer, Francisque Sarcey. Translated by R. E. Dudgeon, M.D. (London: Baillière, Tindall, & Cox, 1886.)—To everyone suffering from short sight we would say, buy and read M. Sarcey's amusing brochure straightway. When we add, though, that it tells how he himself absolutely lost the sight of one eye, and had to submit to the operation for the removal of a cataract in the other, it may appear, to say the least, odd, that it can be possible to apply the term "amusing" to such a narration. Nevertheless we repeat it in connection with a piece of personal history, written with all the brilliancy of one of the most accomplished of French littérateurs, and also repeat our recommendation to all myopes to learn from its pages a lesson which may be of priceless value to them.

THE FACE OF THE SKY FOR MAY.

By F.R.A.S.

[In the preliminary note to this column, on p. 196, we recommended the reader of our notes to provide himself with "The Stars in their Seasons." We would further advise him to procure "The Seasons Pictured," also by the conductor of Knowledge, as he will find the zodiacal maps in it particularly useful in tracing the paths of the planets. The large scale on which they are drawn and the projection adopted render them very suitable for this purpose.]

THE sun should be observed on every clear day, as fine spots and groups still appear at intervals on his surface. Map V. of "The Stars in their Seasons" exhibits the aspect of the night sky. After the 22nd twilight will persist all night long throughout Great Britain. Mercury is a morning star throughout the month. He attains his greatest elongation (26° 16′) west of the sun at 1 A.M. on the 7th. About this time he may be caught by the naked eye, twinkling over the East horizon before sunrise. At 6 A.M. on the 31st he will be only 32′ north of Neptune. Venus is also a morning star, and is, of course, much more brilliant and conspicuous than Mercury. In the telescope she presents a crescent akin to that of the moon in her last quarter. Mars now souths soon, and must be looked at as soon as it is dark enough. He is, though, a comparatively insignificant object, and requires a powerful telescope to exhibit any detail on his surface. He is becoming perceptibly gibbous (*i.e.*, his periphery is less than a circle). He is in Leo (zodiacal map, plate xxv., in "The Seasons Pictured"). On the night of the 23rd he will only be some 3′ south of the star χ Leonis, shown in the map referred to. Jupiter may be seen during the whole of the amateur's ordinary working night, but should be looked at as soon as it gets dark enough. He is travelling in the direction of β Virginis (zodiacal map, plate xxv., in "The Seasons Pictured"). The Satellites of Jupiter continue to present a series of interesting phenomena to the observer. Beginning with May 1, Satellite I. will begin its transit 39 minutes after midnight. On the 3rd the egress of the same satellite will happen at 9h. 22m. P.M., followed by that of its shadow at 10h. 17m. On the 4th, Satellite II. will reappear from eclipse at 12h. 28m. 48s. P.M. On the 6th, Satellite III. will be occulted at 9h. 57m. P.M., reappearing from occultation at Jupiter's opposite limb at 12h. 55m. On the 9th, Satellite I. will be occulted at 11h. 37m. P.M. On the 10th this same satellite will begin its transit at 8h. 55m., and be followed by its shadow at 9h. 56m. The satellite will pass off Jupiter's opposite limb at 11h. 11m., and the shadow it casts at 12h. 12m. P.M. On the 11th, Satellite I. will reappear from eclipse at 9h. 18m. 58s. P.M., and Satellite II. be occulted at 10h. 14m. On the 13th, the egress of the shadow of Satellite II. will happen at 9h. 24m. P.M. On the 17th, at 10h. 37m. P.M., the same phenomenon will occur with the shadow of Satellite III. Later, Satellite I. will enter on to Jupiter's limb at 10h. 45m., as will its shadow at 11h. 51m. The egress both of satellite and shadow will not occur until the next morning. On the 18th, Satellite I. will reappear from eclipse at 11h. 13m. 30s., and Satellite II. be occulted 41 minutes after midnight. On the 20th, the ingress of the shadow of Satellite II. happens at 9h. 12m. P.M. Thirty minutes later, the satellite casting it leaves Jupiter's opposite limb, which the satellite itself does not do until 11h. 58m. On the 24th, the egress of Satellite III. takes place at 9h 58m P.M., while Satellite III. itself actually does not enter on to Jupiter's opposite limb until 11h. 44m. Later, at 12h. 36m., Satellite I. begins its transit. On the 25th, this same satellite will be occulted at 9h. 44m. P.M. On the 26th, Satellite I. leaves the planet's face at 9h. 20m. P.M., as does its shadow at 10h. 30m. On the 27th, II. begins its transit at 9h. 21m., and is followed by its shadow at 11h. 47m. The egress of the satellite occurs at 12h. 10m. P.M. On the 29th, Satellite II. will reappear from eclipse at 9h. 36m. 53s. P.M.; while finally, on the 31st, Satellite III. will enter on to Jupiter's face at 10h. 42m. P.M. Saturn is invisible, a remark applying also to Neptune; but Uranus may be found a little to the south and just to the east of the 3–4th mag. star η Virginis (zodiacal map, xxv., "The Seasons Pictured"). The moon is new at 3h. 42·5m. A.M. on May 4, enters her first quarter at 2h. 20·1m. A.M. on the 11th, is full at 1h. 47·1m. A.M. on the 18th, and enters her last quarter at 11h. 36·1m. P.M. on the 25th. Four occultations of stars by the moon will occur at fairly convenient hours during May. The first one happens on May 6, when the $5\frac{1}{2}$ mag. star 111 Tauri will disappear at the moon's dark limb at 8h. 12m. P.M., at an angle of 114° from her vertex, reappearing at her bright limb at 9h. 3m. P.M. at an angle of 324° from her vertex. At 9h. 42m. on the same evening, 117 Tauri, a star of the 6th magnitude will disappear at the dark limb of the moon, at an angle of 88° from her vertex; but she will have set ere it reappears. On the 17th, η Libræ, a 6th mag. star, will disappear at the dark limb at 10h. 16m. P.M. at a vertical angle of 64°. It will reappear at the bright limb at 11h. 32m. P.M., at an angle of 240° from the moon's vertex. Lastly, on the 21st, when the moon rises, she will have already occulted *d* Sagittarii, a 5th mag. star at her bright limb. Later on, at 10h. 57m. P.M., the star will reappear at her dark limb at an angle from her vertex of 266°. In the description which follows of the moon's path through the sky during May, the figures in parentheses refer to the zodiacal maps in "The Seasons Pictured," and will enable the student to trace her course in the heavens for himself. When our notes begin, then the moon is in Pisces (xxii.), in which constellation she remains until 3 A.M. on the 3rd, when she enters a corner of the most northerly part of Cetus. She takes nearly 12 hours to cross this, and between two and three o'clock the same afternoon passes into Aries (xxiii.). At 4 P.M., on the 4th, she quits Aries for Taurus. She is travelling through Taurus until 6 A.M. on the 7th, when she arrives on the boundary of the narrow northern strip of Orion, which she quits in turn at 6 P.M. for Gemini (xxiv.). Her passage through Gemini occupies her until 9 A.M. on the 9th, when she enters Cancer. She remains in Cancer until 9h. 30m. P.M. on the 10th, when she crosses into Leo. It takes her until 10 A.M. on the 13th to traverse Leo, and she then (xxv.) passes into Virgo. She leaves Virgo for Libra at 10h. 30m. A.M. on the 16th (xxvi.), and is travelling through Libra until 7 A.M. on the 18th, at which hour she arrives at the edge of the narrow northern strip of Scorpio. By 5 P.M. she has traversed this and passed into Ophiuchus. At noon, on the 20th, she leaves Ophiuchus for Sagittarius, as she does Sagittarius for Capricornus (xxi.) at midnight on the 22nd. Twenty-four hours later (*i.e.* at midnight on the 23rd) she crosses into Aquarius across which she is travelling until 4 A.M. on the 27th, when she returns to the constellation of Pisces (xxii.), whence she set out. Continuing her course in the sky, she, at 9 A.M. on the 30th, regains Aries (xxiii.). At midnight, on the 31st, she is on the confines of Aries and Taurus, where we leave her.

COMETS FABRY AND BARNARD.

Fabry's comet is now travelling so rapidly down into the southern hemisphere that it will soon be lost to sight in these regions. On the night of May 1 it will be N.N.W. of the 6th mag. star ξ Eridani; on

that of the 2nd due south of μ in the same constellation; on the 3rd, S.W. of Rigel in Orion's foot; on the 4th, N.W. of α Leporis; on the 5th, due west of δ Leporis, and so on. Barnard's comet too, although it is brightening, is unfortunately situated for the observer, as it is practically invisible until two or three hours after midnight, when it may be detected at a small elevation over the N.E. by N. part of the horizon. Its path commences at the point to the west and south of γ Andromedæ, shown on our map on p. 197, and trends in a south-easterly direction into Triangula. On the night of the 12th it will be due west of β Trianguläe. Hence the comet travels into Aries, and will be found N.E. of α on the 17th. On the 18th it will be N.E. of ν Arietis, and S.W. of ϵ the next night. It will be S.W. of δ Arietis on the 20th, and in the wholly blank south-eastern region of Aries on the 21st and the 22nd. The night of the 23rd finds it S. by E. of ξ Tauri, after which no indication of its path would be likely to be of any use to the observer. All the latter portion of the comet's path may be traced on Plate xxiii. of "The Seasons Pictured."

Gossip.

By Richard A. Proctor.

The *Spectator* sees only wild speculation in the idea that there was ever the slightest reference to sun-worship in the ancient Jewish ceremonial. Possibly it may seem wild to suggest even that the Jewish people or rulers knew anything about the worship of the heavenly bodies. It may surprise the writer in the *Spectator* to hear that not only at the time to which the Jewish ceremonial is referred—mistakenly or otherwise—but long after the time of David, the implements of sun-worship (so to speak) were in use in the Temple itself. My friend, "A Student of Divinity," reminds me of the passage where we are told that Josiah "commanded Hilkiah the high priest, and the priests of the second order, and the keepers of the door, to bring forth *out of the Temple of the Lord* all the vessels that were made for Baal, and the Asherah, and for all the host of heaven," and he put down "them also that burned incense unto Baal, to the sun, and to the moon, and to the planets (the twelve signs it should be, which are, however, the mansions of the planets), and to all the host of heaven. And he brought out the Asherah *from the house of the Lord*, without Jerusalem, unto the brook Kidron, and burned it." &c. The word Asherah, mistranslated "grove" in the Authorised Version, and by some regarded as more correctly to be translated "orrery," seems to have been a wooden symbol of a goddess; and being nearly always found in company with references to the worship of the sun, moon, and planets, was perhaps connected with Sabaistic observances. Some consider that the symbol related more probably to nature worship. "And he took away the horses that the kings of Judah had given to the sun, *at the entering in of the House of the Lord* . . . and he burned the chariots of the sun with fire."

* * *

The question suggests itself here, by the way, whether, in the remote time to which we have to refer the first purifying of the Jewish religion—even if we go no further back than the days of Josiah, instead of turning, as we well may, to the days of the early lawgivers—the priests could possibly have carried out the ceremonial system described in Leviticus and Numbers without using some sort of astronomical instruments. We know that Moses and others of the early guides of the people possessed astronomical knowledge. Moses was "learned in all the wisdom of the Egyptians," which included astronomy. The Egyptians and Babylonians regulated their fasts and festivals by astronomical observations; and no doubt the early Jewish teachers knew how to do astronomical work with all such accuracy as was necessary for determining their months (lunar) and passovers (annual). May not a sacred significance have come to be attached in later times to the instruments—wooden circles, quadrants, direction-bars, and so forth—which had been preserved in the Temple from those early times when they were necessary for determining times and seasons? May not the Asherah, instead of being an orrery (which is rather an absurd interpretation) have been the name given to these ancient observing instruments?

* * *

Of course, to persons ignorant of astronomy, no difficulty arises from the considerations I have here suggested. They speak and write sometimes as if they thought the high priests had "Whitaker's Almanac" to refer to, to tell them the times of new moon, of the vernal and autumnal equinoxes, and so forth. My own opinion is that Moses was *not* acquainted with "Whitaker's Almanac." This, however, may seem to the *Spectator* "a wild speculation."

* * *

This being so, those who had to carry out the Jewish ceremonial system *must* have had some astronomical knowledge, and must have made some astronomical observations, and that, too, in a systematic manner.

* * *

The *Topical Times* objects, and really with some apparent reason, that in mentioning a criticism which really appeared in that paper I did not name the *Topical Times*. I had this sufficient reason that the criticism was cut out from the *Topical Times*, and the name of the *Topical Times* was not appended to that *Topical Times* criticism. (I am trying hard to repay my obligation to the *Topical Times* for so often mentioning my name.)

* * *

The *Topical Times* asks what *is* a "cheap critic." The term is free from offence. It does not refer to the quality of the critic's mind, or the value of his opinion, but to the price paid him for his work. I know very well what cheap criticism is, for long ago I was more than once invited to supply it; and I might have supplied it, too, just as a man might break stones for a shilling a day, if I had not had more profitable employment for my time. (There is no shame in working cheaply, though there may be loss of name, for how can the public know the beggarly nature of the wage for which the poor work may have been done.) As a sample, I may mention how a wealthy firm of publishers (who have published no work of mine, let me note) once sent me a book of six hundred pages, or thereabouts, to be reviewed "in a quarter of a column" (10s. 6d. being the pay per column) "and *returned!*" If I had done that work, even if I had given good work for the half-crown, I should decidedly have been for the nonce a cheap critic.

* * *

The *Topical Times* finds my name as often in the March number as in the February number of Knowledge; but I fancy if the number of columns had been counted a considerable difference would have been found. Albeit, both the February and the March numbers included matter which had been for months in type, and had to be used before Messrs. Spottiswoode undertook the printing. I might add that the April number and the May number have both had to be got ready much earlier than of yore, and the contributors to Knowledge have not always been able to come up to time, so that I have had to supply more matter than usual.

But, to say the truth, I am not concerned to deny that I take and need a good deal of room in Knowledge. The number of those who are ready to work on the lines I have adopted is not great. Too many of our students of science are unable, apparently, to escape the idea that there is a loss of dignity in using plain untechnical words. I cannot get from such men the kind of writing I want. On the other hand, many students of science who are willing enough to write plainly are either not sufficiently acquainted with scientific subjects or mistake the childlike and bland for the simple and clear. They are ready to fill column after column with trivialities and inexact platitudes, under the idea that they are writing about science. Our way is strait, and there are at present very few who walk in it. Many profound thinkers there are, and many writers who possess an excellent style, but the true thinkers who will, and can, write clearly are not many.

* * *

The *Topical Times* says, rather neatly, that I ought to take for a motto for Knowledge "*Le Savoir : c'est moi.*" Neat, not goady ; for there is some truth in the suggestion that Knowledge depends a good deal on me. It was my idea to start a paper in which scientific discoveries (not mine) should be brought before those who are not specialists in science. Our monthly magazines had and have (I hope they will long have) articles such as I want to see in Knowledge. But they depend for their circulation on novels and stories, politics and poetry. The articles which make the substance of Knowledge make the padding of the monthly magazines. It may perhaps suggest itself, even to a cheap critic (in this sense that he has to review a magazine in perhaps half a dozen lines, and therefore for but a moderate sum), that in such a venture there was, and is, some degree of risk. We cannot have the support of novel-readers as the monthlies have, of scientific specialists with *Nature*, of general literature students with the *Academy* and *Athenæum*, or of mechanics with *Iron* and the *English Mechanic*. We may get readers from all those classes, but certainly we cannot expect the support of those classes as such. This being so, perhaps the *Topical Times* may find less to wonder at in the circumstance that I, who started the idea and ran all the risks, should also do a large proportion of the work. This, thought over a little, may be found to imply neither the self-sufficiency nor the want of generosity which the *Topical Times* would apparently attribute to me. If the *Topical Times* knows of anyone ready to start a magazine, supplying the same special kind, quality, and amount of material as is given monthly in Knowledge, and at the same price, I shall be very glad to hear of it. But as matters actually stand, I know that I have no occasion to defend or excuse aught in the conduct of this paper, but rather, were the truth only known, very much the other way. Hitherto, if I have supplied, as I think, a want, I have done so at a pretty heavy price. I have had to work elsewhere than in Knowledge to meet it.

* * *

As readers of Knowledge know, I have nothing of what is commonly miscalled loyalty. I simply do not understand it, at least as a feeling to be entertained by grown men ; as a child, and even for several years after childhood, I knew it well enough ; and for this reason I assign the feeling to that early stage in the development of our races, of which the feelings of childhood or of boyhood bear witness. Indeed, we need only consider the requirements of savage races to see that personal "loyalty" is a useful and desirable race quality. Devotion to a chief (even though he may be of the piratical type, like Rollo the Norman or Kerdic the Saxon, from whom the royal family of England derives its title) was of old devotion to race, nay, even to family. It was essentially a duty in savage times to be ready to fight to the death for chief and ruler, even though instead of faith and fatherland that meant fighting for plunder and other folks' land. Now, matters have to some degree altered. Even if science would permit us to believe that the present inheritors of royal title inherited a trace of the fighting qualities of the old pirate chieftains, we now no longer recognise these qualities as in any way valuable or even respectable. Loyalty to one's fellow-men no longer includes special loyalty to a family or a person,—nay, the word "loyalty" so applied is absurd to those who see things as they really are.

* * *

But while I thus rather despise personal loyalty in all but the young or uncultured, I must confess to a strong feeling of indignation at the gross rudeness shown by many to the members of the royal family. When I read that perfectly inoffensive, nay, probably most excellent and amiable ladies, are so pursued and intruded upon by boorish and unmannerly persons, that they are prevented from taking their walks abroad as other people do, I wonder that some measures have not been taken to remedy so gross a wrong. I suppose the trouble is that women share in the offence. The summary measures which would be appropriate for boors of the masculine persuasion could hardly be applied to the females of the race.

* * *

In another way, another lady of the royal family of England, in fact the head of the family, has recently been rather rudely treated. One can hardly view otherwise, I think, the comments made on two kindly letters written by her recently to another lady who has recently known sorrow. The publication of the letters, having had the queen's sanction, was doubtless permissible, though one rather wonders at it. But the comments made in many journals on the circumstance that such letters were written, were surely offensive to a degree. They may not have been so intended. As Philip Firmin says, there are some people who are offensive without meaning to be. But what could be more offensive than a tone implying absolute *wonder* that the queen should be a kindly woman, touched by sorrows akin to those which she has herself known in the past ?

* * *

I am glad to be bringing to a close the hardest lecturing season I have ever undertaken—or rather which has ever been arranged for me. Giving *carte blanche* to an agent to manage such lectures as could be managed, I have found considerably more lectures and travelling than I could well manage arranged for me. But I have now nearly got through the work (shall have quite got through it by the time these lines appear) and yet I remain alive ! In fact at the beginning of the set of nearly 200 lectures, in last August, I was very ill, and now—thanks—I am as well as I ever remember to have been in my life.

* * *

Odd experiences come to the lecturer who lectures often enough. The other day in Ireland, after giving a carefully reasoned lecture (as I thought), only simple in being divested of technicalities, my chairman (or rather the chairman invited to preside by the committee, for *I* never want chairmen) asked me, "Er—do you know really much about astronomy ?" and on my replying, with characteristic modesty, that were I to say I knew much I should show I knew little, the worthy officer (for he was a military man) proceeded, "Er—because —er—I always thought you wanted 'algebrah' for astronomy ?" to which I did not reply that one also needed the alphabet in literature.

The Belt trial closed as the last number of Knowledge was going through the press. I am not anxious to adopt the We-told-you-so style; but as I was very roundly abused by fully a hundred readers of Knowledge for pointing out, after the former Belt trial, that, let the merits of plaintiff and defendant be what they might, the principles laid down by the judge and adopted by the jury were entirely unsound, I may venture to dwell on the extreme probability now indicated in favour of the belief that the decision of the jury in the earlier trial was erroneous. For the principle at issue was an important one. An artist has, perhaps, little better power than the non-artistic public to pronounce what is great or beautiful in his own art. Had that only been asserted, no harm would have been done. The poet is often a bad judge of poetry; the painter a bad judge of pictures; and so on. But when it is a question of deciding on matters belonging to technique or execution, the opinion of one expert is worth that of a thousand who are not experts, and if all the experts called on to pronounce an opinion on such matters agree, nothing but the belief that they are dishonest should prevent men of sense from accepting their opinion as decisive.

* * *

I regret much that serious illness, now lasting several months, has prevented Madame de Gottrau from continuing the excellent series of papers which she had commenced on music and on art a short time since. I hope these papers may shortly be resumed. In a few weeks I shall probably have the pleasure of meeting their writer at Munich, and arranging—if her health permits—for the completion of both series.

* * *

Owing to the Easter arrangements, or misarrangements, this number had to be unusually early in the printers' hands. Odd that the passage of the sun across the equator and of the moon in her monthly cycle, moving men in ancient and semi-savage days to special astronomical observances, and so affecting the ceremonial arrangements of later days should modify the movements of our printing establishments, and the arrangements of publishing houses, in this age, which is about as free from sun-worship and moon-worship as it can well be! But when we think that because (primarily at least) the planet Saturn seemed to old star-worshippers a gloomy and melancholy god, our shops are closed now on the day which has replaced his (and on his day among our Jewish kinsfolk), scarcely any peculiarity of that kind can seem very strange.

* * *

The University boat-race always brings out a crop of absurdities in the newspapers; but I think the last race went beyond all others in this respect. Some of the absurdities were not merely, as usual, imbecile, they were absolutely idiotic.

* * *

I remember a report of one of the finest races ever rowed for the Wingfield Sculls, which struck me at the time as the finest piece of nonsense I had ever read. The two men were well matched; they both sculled in splendid style from start to finish; and though both had done their best over the course, neither was used up at the finish, for they were both in first-rate condition. Each could certainly have sculled five miles—ten minutes after the race was over—at a pace which would have taken the heart out of any but a first-class sculler in good training. In describing this race, the reporter of a leading newspaper discovered a number of things which no oarsman would have found out. The race was won by two lengths—A., let us say, being the winner, and B. the loser—the whole race being stubbornly contested throughout. But the reporter discovered, with his penny-a-lining eye, that B.'s left arm had "given way" after the first three quarters of a mile. A little later B.'s right arm followed suit. Presently, as if the loss of both arms were not enough, B. went "all to pieces," and was "manifestly powerless." In the meantime, to be strictly fair to both parties, the reporter observed that obviously A.'s left wrist had "gone" (where he omitted to say), and the rest of the race was rowed almost wholly with the right arm—a very wonderful performance indeed, which a Casamajor or a Playford might have envied. Somehow the one-armed sculler managed to get over the $4\frac{3}{4}$ miles in splendid time, and the armless sculler, all in pieces as he was, came in but two lengths behind—and lengths are not long in a sculling match.

* * *

The reports of the recent race are even funnier in some respects than the marvellous descriptions given in former years. The condescendingly explanatory tone employed by the experienced sportsmen who wrote them is impressive to begin with. Everyone (the *Standard* said in a leader) who knows anything about rowing will understand what such a struggle meant. It was won by Cambridge, it appears from this article, in the following unexpected way. "When the struggle of the last few moments began, the Cambridge crew, hitherto defeated (!) had gained what is called" (so kind to explain) "their second wind" (!!) "and upon the strength of that went in and won." Conceive the condition of a crew which had rowed over four miles before gaining what is called its second wind, and imagine what sort of a crew Oxford must have had to be beaten by such a lot. (I have not been in training for a quarter of a century, and am entitled to be "scant of breath" for other reasons, yet I get "what is called" my second wind in running up four or five flights of stairs, and in hard rowing for a couple of hundred yards.)

* * *

I know some men, especially when out of condition, are slow in getting their second wind. I remember how a big man in our Johnian four failed to get his second wind till a mile of the one-and-a-half mile race had been rowed, and the race was lost through the difference that made. But he was not in good condition, and was constitutionally weak (though of Herculean build above the knees), and was spitting blood after the race; so that case was exceptional. Every member of a well-trained crew ought to have his second wind before the first quarter of a mile is covered. It is not a bad plan, by the way, for a crew to take a breather—running—just before the start, so as to be already working the whole lungs in the manner meant by "what is called the second wind."

* * *

To the reporter for the *Echo*, writing after the race, it was "obvious," early, that Cambridge was by no means beaten, entirely obvious "that it was anybody's race," and "conspicuous that the Oxford men could no longer retain the advantage of the station." Yet this clear-sighted observer recognised that in the middle of the race the Cambridge crew were "all abroad,"—which the reporter might have been, for any intelligent interest he can have taken in the race.

* * *

So also the *Daily News* reporter discovered that at one part of the race the Cambridge crew were "within measurable distance of going to pieces," but were saved, and the race won at this stage, by the devotion of their stroke in picking them up and pulling them together. Mr. Pitman will appreciate the compliment, as will everyone who has ever rowed stroke in a race; for if a stroke has to steady his crew and save them from going to pieces, the chances are ten

to one that the fault has been with the stroke himself. But the whole description is absurd on the face of it. The reporter hears a number of remarks made by persons around, whom he fondly imagines to be experienced rowing men; and, having to write as if he himself knew something about rowing, he puts in these absurdities as the results of his own experienced observation. Neither of the crews which rowed that gallant struggle on the 3rd were all abroad, or went to pieces, or were within measurable distance of accomplishing either achievement, from start to finish.

* * *

IN the course of the hard-fought struggle, one or other boat, in a bit of lumpy water, takes a rather bigger roll than usual, and two or three of the oars catch the top off a wave. Then some backer of the other boat, knowing nothing of rowing, calls out, "Cambridge (or Oxford) is going all to pieces! Look how they're splashing!" On this the reporter, who very likely has not at the moment been looking at either boat, takes his pencil and writes down quickly, "Here Cambridge (or Oxford) began to show conspicuous traces of the strain which had been put upon them. It was evident to those conversant with boat racing that they were all abroad. They splashed terribly on the bow side, bow and two being particularly noticeable in this respect" ("two" is not on the bow side, but what matters?); "in the after-part of the boat they were steadier." Evidently the experienced reporter supposes the bow side to be the forward half of the boat; and people down in the country read the account, in natural wonder at the acumen of the London papers, and also at the marvellous pluck by which a crew in pieces and all abroad managed, after all, to win a closely-fought struggle.

* * *

ABSOLUTELY the funniest account of all, however, is the following in the *Yorkshire Post* :—

Not only did the Cambridge crew possess speed, but they had extraordinary stamina, and, what is more, an excellent coxswain. The way he bored the Oxford boat in the first mile, so as to give his men as much possible benefit of the tide, was a piece of steering in which he ran great risk, and again he was equally as clever through the temporary structure at Hammersmith, where the crews were nearly level. Cambridge then began to lose ground, and when daylight appeared between the boats as they reached Barnes Bridge all hope seemed to have vanished so far as the Light Blue crew were concerned. It seemed any odds, and had there been professional betting men on the steamer like we meet in sculling races I have no doubt that we should have heard extraordinary odds offered on Oxford. The reporters had finished making notes, and the artist with his instantaneous photographic machine had ceased to take further views of the contest. We had but about half a mile to go, and to the eye Cambridge were in hopeless pursuit of a crew who had in fact taken their opponent's water. But in a shorter time than it takes to tell it it was observable that Mr. Pitman's frequent calls upon the crew had reduced the gap, and quickly following upon this new life seemed to be thrown into the boat. Spurt after spurt on the part of Cambridge caused the Oxford coxswain to leave the Cantabs' water, and I shall never forget the wild and exciting yells that came forth from the steamer carrying the partisans of the Light Blue crew. A quarter of a mile from home Cambridge were again almost level with their opponents. Whether the latter had spun themselves out in trying to maintain their lead [!], or that they became scared [!!] when Mr. Pitman placed his crew in close quarters, I am unable to say, but Oxford went to pieces all of a moment [!], and in the last hundred yards Cambridge snatched the verdict out of the fire by, to use the official words of the judge, "two-thirds of a length." In every sense it was a grand race, and, as one might have expected, several of the men were very much baked by the pressure of their ever to be remembered struggle. Still, more than one waved their hands in the Cambridge crew when the gun fired, and least distressed of all was Mr. Pitman, who, in picking up his men off the Brewery at Mortlake, is recorded to have put in 21 strokes in 30 seconds. A marvellous performance! [A stroke of 42 to the minute is not *very* wonderful in a spurt; in old times 47 or 48 to the minute would often be noted, though now 42 to the minute is about as much as any good stroke would care to go to, even in the fiercest spurt. But increasing the rate of striking *would* be a rather marvellous way of "picking up" an unsteadied crew.] But this grand stroke of the winning crew, aided by Mr. Barclay at No. 7, won the race. [Poor balance of the crew! Of course they did nothing towards winning the race: Oxford being 'spun out,' and "scared" and "all to pieces" from that fatal "moment," Cambridge rowed in as a winning "pair oar" with six "passengers"!]

Our Whist Column.

ON THE ORIGINAL LEAD.

BY MOGUL.

PART II.

WITH the view of settling by authority the question under discussion, I drew up the following hands, with the questions at foot, and got as many opinions as I could from players whom I knew personally to be fine players, or who were so considered by those on whose judgment I could rely. The hands have been submitted to Cavendish, but I have not been favoured with his views thereon.

Hands.	Trumps, Spades.	Clubs.	Hearts.	Diamonds.
No. 1	Kg., 8	10, 9, 7, 6, 4, 2	A., Kg., Q.	Kn., 10
" 2	9, 8	9, 8, 7, 6, 3	A., Kg., Q.	A., Kg., Q.
" 3	5, 3, 2	10, 9, 8, 7, 6	A., Kg., Q., Kn.	Kg.
" 4	5, 4, 3, 2	5, 4, 3, 2	A , Kg., Q.	A., Kn.
" 5	Q., 4, 3	Kg., 6, 5, 2	Q., 7, 6, 3	Q , Kn.
" 6	Q., 10, 9	6, 5, 4, 3, 2	Q., Kn., 10	Kn., 10
" 7	Q., 10, 9	Kn., 8, 7, 4	10, 8, 6, 4	Kn., 9
" 8	Kg., 6, 2	Kn., 6, 5, 4	Q. Kn., 10	Kn , 10, 9
" 9	9, 8, 5, 4	Q., Kn., 8	Kn., 10, 2	A., Kg., Q.
" 10	A , Q., 10, 2	Kg., Kn., 3, 2	Kg., Q , Kn.	10, 9

What card should first player lead from above hands—first, when the score is love all; and secondly, when the score is four love?

ANALYSIS OF RESULTS SHOWING THE NUMBER OF TIMES THE VARIOUS LEADS WERE RECOMMENDED.

No. of Hand.	Trumps.	Clubs.	Hearts.	Diamonds.
1	—	5	25	2
2	6	2	24	—
3	—	1	31	—
4	4	1	25	2
5	—	20	—	12
6	—	8	23	1
7	—	26	—	6
8	—	12	20	—
9	12	3	—	17
10	11	9	11	1
	33	87	159	41

Total results 10 (hands) × 2 (states of score) × 16 (opinions) = 320.

Now, omitting for the present hand No. 9, in which the trumps are the longest suit and the other suits are of equal length, it will be observed that in all the other hands the Club suit is either the longest suit or, as compared with any other of equal length, the strongest; and, omitting also all cases of trump leads, there are only 84 Club leads, as compared with 183 leads of other suits. This proves that the long-suit theory is not generally adopted as a rule of faith. Taking only hands Nos. 4 to 8 inclusive, which many people will consider the most crucial, there are only 67 Club leads against 89 of other suits. In No. 4 there are only 5 leads from a four suit, as against 27 from a shorter suit. It would therefore seem that Cavendish's advice on the lead from such a hand is generally disregarded. No. 7 is the hand where the results are most opposed to my own views, there being 26 Club leads against 6 of a strengthening card; but I get my revenge in hands No. 6 and 8, there being only 20 Club leads against 44 from a suit of only three or two. Although No. 5 is also opposed to my views, I should be obstinate indeed if I did not feel that the lead from King and three

small ones is far less objectionable than a lead from Knave or Ten and three small ones.

As the above results do not include my own opinions, I hope that, having had the advantage of learning the ideas of other players, I may, without presumption, submit for criticism my own ultimate views on the various leads.

1. The chance of bringing in the long suit is so remote that it ought not to affect the original lead; the lead of the Knave of Diamonds and afterwards of the ten might be so very useful to partner that I should at the score of love all commence with the D. Knave, but at 4 love should lead out Hearts at once, as delay would increase the chance of their being trumped.

2. The chance of getting in the long suit is so good that I should commence with a trump or from long suit at score of love all, but at score of 4 love should make a rush to secure making the two tierce majors.

3. The Heart King at both scores (there is only one dissentient to this).

4. As there is no reasonable chance of winning the game, an original lead of Spades or Clubs would, in my judgment, be absolutely wrong, the Hearts should at both scores be led out in the hopes of getting some intimation from partner or adversaries. If none obtained, then lead out Ace and Knave of Diamonds, so that partner need only hold one honour and win one trick to save game.

5. I should lead the D. Queen because it may do much good, and cannot do much harm, and it would be so much better if the other suits were opened by the adversaries.

6. In this hand also the expectation of bringing in Clubs is too small to justify opening that suit. I should therefore lead Queen of Hearts or Knave of Diamonds, preferring the latter so as to better secure the opportunity on getting in with the Hearts of leading the ten of Diamonds. As this reason has not struck any other player, it may be far-fetched, but I fancy it is sound.

7. I should not like to lead from either four suit, which might terribly weaken partner without any benefit to oneself, but would try to assist him by leading Knave D.

8. This hand is very similar to No. 6, the distinction being that there is somewhat less risk in leading a Club, and somewhat more chance of making a long one, still, as only one long Club could possibly be made, the best lead at both scores would be the Queen of Hearts or Knave of Diamonds—for reasons given at trick six I should somewhat prefer the latter.

9. The strength in plain suits justifies, nay demands, a lead of trumps at the score of love all, but hardly so at the score of four love, when I should start with the Diamonds; the player with whose opinion I least like to differ would, at score of four love, play Club Queen; but, I must confess, that if I did not lead the Diamonds, I should prefer Heart Knave, and for this reason, that if anybody else opens Clubs, one is almost sure to make a trick in the suit, but the chances of doing so are diminished by opening it oneself.

10. The strength in trumps, coupled with the strength in plain suits, makes a trump lead at score of love all but imperative, but it seems to me that at score of four love the lead should be Heart King, as that offers the best chance of making one's own good cards without damage to partner, and of thus securing the odd trick. If one opened the Club suit, and partner had nothing in it, the chance of making the odd trick would be materially diminished, much more so than if Clubs opened by either adversary.

Our Chess Column.

By "Mephisto."

A Hard-fought Game.

The following game was contested in a recent handicap tournament between Messrs. Gunsberg and Fenton, the former yielding the odds of pawn and two moves. The game abounds in intricate positions and fine points. We therefore append to the game full explanations and notes, which will render this game a useful, and, let us hope, also an agreeable study.

Remove Black's KBP.

1. P to Kt.	
2. P to Q4.	2. P to K Kt3.

This, we believe, is considered inferior to P to K3, but there is really no good move. Judgment is all-important in giving odds, and against a player who thoroughly knows the ordinary game it is best, even at some risk, to play an unusual opening.

3. B to Q3	3. B to Kt2
4. P to QB3	4. P to Q4
5. P to K5	5. P to B4
6. P to KR4	

Black's weak spot is on his K side. White threatens a great deal by P to R5; for if Black takes the P, the Q checks, and disarranges Black's position considerably. If Black does not take, then White exchanges his RP for Black's KtP, and we do not see how Black can defend it. If Black plays P to K3 with a view to protecting his P, then 7. P to R5. Kt to K2; 8. B to KKt5, &c.; besides, P to K3 shuts in Black's QB.

	6. P × P
7. P × P	

This is safe, and unobjectionable. White might, however, have got a considerable attack by playing 7. P to R5 at once, supposing P × BP. 8. Kt × P or P × KtP, &c.

	7. Q to Kt3
8. Kt to QB3	

This also is reasonable, for the Kt attacks the Black QP. White, however, receives odds, which should induce him to play with energy, for with every move Black gains time for development. 8. P to R5 would have been difficult to meet. If Black's P becomes isolated, he will fall very soon. 8. Kt to QB3, however, seems a very good move, as apparently Black cannot defend the QP by the B without cutting off his Q from defending the P on Kt3. P to Q3 would not do at all on account of both P to R5 or Kt to Kt5.

	8. Kt to QB3

It is of paramount importance not to be restricted to mere defending moves. Black hereby gains time at a critical moment in the opening. The complication of a manœuvre helps towards its success, a fact which must never be lost sight of by a player giving odds. Kt to QB3 was a perfectly sound move. If White plays 9. Kt × QP, Q to R5 (ch). 10. Kt to B3, Kt × QP. 11. B × P (ch), P × B. 12. Q × Kt, B × P, and Black has got rid of his difficulties, although he has not gained anything.

9. KKt to K2	9. B to Q3
10. P to R5	10. P × P

Again straining a point in order to develop his game, Black could also have defended his KtP by B to B2, but then follows 11. P × P with a strong game.

11. R × P	11. Castles

The only other alternative was P to KR3. 12. B. to Kt6 (ch). K to Q2. Black, in giving up the RP, also had certain faint hopes of attack on his R's file, hopes which soon assumed a real form.

12. R × P	

After 12. B × P, White was needlessly afraid of his B remaining pinned.

	12. Kt to R3 !

Black.

White.

A very bold bid on the part of Black to take advantage of his development to create complications, and at the same time a perfectly sound move. If 13. R × B, Kt to B4. 14. B × Kt, R to R8 (ch), winning the Q. Again, in reply to 13. R × R, R × R. 14. B to K3. Kt to KKt5. 15. Kt to Kt3, Black can play Kt × QP, or against other moves in this interesting position some attack will always result for Black. Finally, if 13. B × Kt, B × B, Black again has a good game.

13. Q to Kt3.	

No doubt the best reply, as now the command of the R file is of less advantage to Black.

	13. Kt to QKt5
14. B to Kt sq.	

This seems preferable to R × B. A very ingenious defence, involving the temporary sacrifice of a piece, was pointed out to us, as follows: 14. Kt to R4, Kt × B (ch). 15. Q × Kt, Q to R4 (ch). 16. B to Q2 ! Q × Kt. 17. R × R, R × R. 18. Q to Kt6, with a good game.

	14. Kt to KB4

It was an open question whether this move or R × R should have been played first; perhaps the latter.

15. R × R	15. R × R
16. B to K3	

B × Kt would give Black command of the square on QB7.

	16. Kt × B
17. P × Kt	17. B × P !

At last the tactical advantages have turned into something substantial, and Black has one P back. Should White play 18. P × B, then Black plays Q × P ! and White is threatened with the mate by R to R8.

18. K to K2	18. B to Q3
19. P to R3	19. Q to R4

Of course White can force the exchange of Queens by 20. Q to R4. Black was, however, quite right in giving himself another chance of avoiding the exchange, which would necessarily have followed on his moving the Kt.

20. B to R2.

This is weak, and again gives Black a tactical advantage. White had a fine move at his disposal in 20. B to K4; he thereby effectually defends his weak K Kt P, as Black cannot well take the B.

	20. Kt × B
21. Q × Kt	21. R to Kt sq
22. P to Kt3	

White cannot defend this P, for if 22. R to K Kt sq, B to R7, he therefore aims at effecting exchanges.

	22. B × P
23. R to K Kt sq	23. B to Q3
24. R × R	24. B × R
25. P to Kt4	25. Q to R3
26. P to Kt5	26. Q to R4
27. P to K4	

White wants to exchange as many Pawns as possible; Black tries to retain his two Bishops, which, as will be seen from the following ending, are of great power. 27. P to R4 was White's best.

	27. B × P
28. P × P	28. Q to Kt5

limiting the action of the White Q if 29. Q to B2, B × P

29. K to K3

To release the Kt,

29. B to R2.

Still preventing the Queen from coming into play *viâ* B2.

30. P to K6.

White has throughout this game shown superior steadiness and judgment. Seeing that he slowly loses ground he gives up two Pawns in succession for the chance of bringing his Queen and Knights into the game, and getting possibly drawing chances.

	30. Q × P
31. Q to B4 (ch)	31. K to Q2
32. P to Kt6	

White's hold is the position of the B on R6 and Q to R4 (ch) if P × P Black's Pawns become weak, although we think Black should win, yet it is difficult to decide, if a draw is undesirable.

	33. P to R3
34. Q to R4 (ch)	34. K to Q sq
35. Q to R5	35. Q to R3 (ch)
36. K to B3	

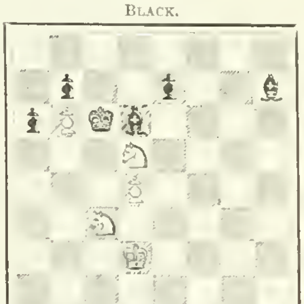
Here K to B2 would have been better. Black cannot do anything by continuing checking.

	36. B to Q3
37. Q to Q5	

This gives Black the opportunity of getting a winning ending by exchanging Queens.

	37. Q to R8 (ch)
38. K to K3	38. Q × Q
39. Kt × Q	39. K to Q2
40. Kt(K2) to B3, K to B3	
41. K to Q2	

Black.



White.

If White had played 41. K to B3 with a view to playing K to K4 if B attacks Kt, Black would not have played either B to K Kt sq. or P to K3, but 41. P to R4, the advance becoming dangerous.

	B to K Kt sq.
42. Kt to K3	K × P
43. K to B2	P to R4
44. K to Kt2	K to B3
45. Kt to K4	B to B5

This is weak and loses a good deal of Black's advantage. He might safely have advanced his P to Kt4 or played B to B2.

46. Kt to K B5

The correct move, and wins a P; for if K to Q2, then 47. Kt to B5 (ch), &c.

	46. K to Q4
47. Kt to B5	47. P to Kt4

Of course, if Kt × P (ch), K × P, and the Kt remains attacked.

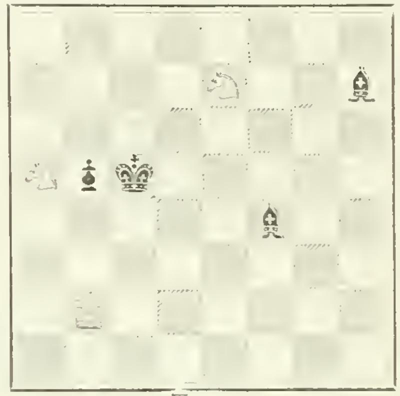
48. Kt to QKt7	48. B to R2

The idea being to cut off the Kt if possible. Black had, however, a better reply in B to Kt4, for then, if 49. Kt × RP, P to K3, and Black will win the QP and have two Pawns clear.

49. Kt × KP (ch)	49. K × P
50. Kt × P	50. K to B4

In this position the game was adjourned after six hours' play, the position forming a useful end-game study.

Black.



White.

51. Kt to Kt3 (ch).

It seems natural for White to endeavour to retreat his Kts for the better protection of his K. It may be, however, that Kt to Kt7 (ch) would have made winning a little more difficult. The end-game is rather interesting, as showing the great strength of two Bishops. We believe that Black can win whatever White does.

	51. K to Q3
52. Kt to B8 (ch)	52. K to Q2
53. Kt to R7	

53. Kt to Kt6 (ch) is more plausible.

53. B to K4 (ch)

A very important manœuvre. Black intends to advance his P to Kt5, so as to further limit the movements of the Kt after Kt to Kt4. Black must advance the P as he cannot play B to Q6 on account of Kt to B5 (ch).

54. K to R3.	54. B to Q3 (ch)

A welcome check, which prevents Kt to B5.

55. K to Kt2	55. P to Kt5
56. Kt to Kt4	56. B to K4 (ch)
57. Kt(Kt3) to Q4	

This looks best, for it not only gives the White K more room, but the Kt also cuts off the Black K entirely.

	57. B to KKt sq!
58. K to B2	58. B to QB5
59. K to Q2	

This is surrendering to the enemy. A good fight would result if White had played 59. Kt to KB3: probably P to Kt6 (ch); 60. K to Q sq, B to B5; 61. Kt to B3, B to Q6; 62. Kt to Q2, P to Kt7; 63. Kt to Kt sq; and Black must advance with his K.

	59. B × Kt(Kt5)
60. Kt × B	60. K to B3
61. Kt to R7 (ch)	61. K to Kt2
62. Kt to Kt4	62. K to Kt3

Resigns.

Contents of No. 6.

TERMS OF SUBSCRIPTION.

"Knowledge" as a Monthly Magazine cannot be registered as a Newspaper for transmission abroad. The Terms of Subscription per annum are therefore altered as follows to the Countries named:—

	s.	d.
To West Indies and South America	9	0
To the East Indies, China, &c.	10	6
To South Africa	12	0
To Australia, New Zealand, &c.	14	0

To any address in the United Kingdom, the Continent, Canada, United States, and Egypt, the Subscription is 7s. 6d., as heretofore.

KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART

LONDON: JUNE 1, 1886.

THE UNKNOWABLE.

By Richard A. Proctor.

A DIGRESSION CONCERNING THE NAME AND PURPOSE OF THESE PAPERS.

As the purpose of this series of articles—originally indicated very fully—seems to have been forgotten by many, and several correspondents, as well as outside critics, have renewed the old mistake of describing the Unknowable as that of which we neither know nor can conceive anything, I make here a few remarks as to the fundamental idea on which the recognition of the Unknowable depends.

To unthinking persons, having it may be feared somewhat shallow minds, it appears as though there could hardly be a much greater blunder than to speak of the Unknowable as if we knew aught about It. Even one of comparatively trained, though somewhat fanciful mind, like Mr. Frederick Harrison, could jeer at Mr. Spencer for going so far as to speak of the Power which lies at the back of all phenomena as certainly unknowable; for, said Mr. Harrison, it is "more philosophical not to assert of the unknown that it is unknowable." Again, "to assert the presence of one uniform energy," said Mr. Harrison, "is to profess to know something very important about the Unknowable," as if nothing could possibly be known about that which is admitted to be unknowable.

But in reality we not only know something, we know what for us is *much* about the Unknowable. It may truly be said that *all* we know is knowledge about the Unknowable. This sounds like saying, "We know all about the Unknowable," or, more shortly, "We know the Unknowable," either of which is an utterly self-contradictory saying. But in reality there is no such contradiction. Nay, one may present with truth a seemingly more obvious paradox: for one may truly say—

Everything we know we know about the Unknowable, yet of the Unknowable we know (in effect) nothing.

This which seems so obviously and undeniably absurd is simply a truism to all who have been led to contemplate the Unknowable by advancing along the track which the students of the knowable have followed until now, and which I am tracing in these papers.

In order to show that, instead of being a paradox, the saying just imagined is a mere truism (in these days, and for the thoughtful student of science), we may compare it with either of the following manifest truisms:—

Everything we know we know about the Universe; yet of the Universe we know (in effect) nothing.

Everything we know about the occurrence of events we know about events occurring during all Time; yet of the events occurring during all Time we know (in effect) nothing.

Everything we know about the dimensions of bodies and systems in space around us, we know about bodies and systems occupying infinite space; yet of Infinite Space we (in effect) neither know nor can conceive anything.

Everything we know we know about the Infinite, for the Finite is a part of the Infinite; yet of the Infinite we (in effect) neither know nor can conceive anything.

We need not take infinity, however, to find similar apparent contradictions, which are in reality no contradictions at all. Thus we may write:—

The distances of the millions of stars in our galaxy are unknown and unknowable; yet we know much about those distances.

The region around the earth's centre is unknown and unknowable; yet we know much about its nature and condition.

The depths of ocean must be regarded as unknown and unknowable; yet we know a good deal about those depths and their tenants.

Or, to turn from the great to the small:—

The ultimate structure of microscopic forms (animate and inanimate) is unknown and unknowable; yet we know a good deal about it.

Or, to take concrete examples:—

The Emperor of All the Russias is unknowable for some average Englishman, whose whole life is passed, say, in Truro; and the Cham of Tartary may even be so far unknowable that of his actual existence to-day such an Englishman may be doubtful: yet that same Englishman, if decently educated, as an average Englishman may be expected to be, knows a good deal about the Emperor of Russia, and could quote many passages from well known authors relating to the Cham of Tartary, in the days when the Cham of Tartary was a recognised power.

What I am trying to do in these papers is to show how men of all races and in all ages have recognised mystery and power in the unknown which was for them unknowable, their ideas of the unknown power widening as the domain of the known widened and so disclosed the ever-widening domain, the ever-deepening mystery of the unknown and the unknowable, until now the Unknowable is recognised as without limits either in time or space. Its mystery is too profound to be fathomed.

That this should seem like atheism to the ignorant, who either need and believe in a finite deity, or else reject with unnecessary indignation a deity of that sort (the only deity suiting ignorant minds), is natural enough. As a shallow critic has remarked in the pages of a contemporary—Religious and irreligious, meaning those who arrogate to themselves the title religious and those who as arrogantly reject religion, agree in recognising Darwin and Spencer, Huxley and Tyndall, and all who think like them, as atheists. But then, the opinions of such persons count simply as nothing. The early Christians were promised safety if they abjured atheism, and doubtless their belief seemed like atheism to the believers in the divinity of sun, moon, and planets, or of other nature-gods; but the early Christians knew that they were not atheists, and regarded the belief of those outside their body as the true atheism for their day. So the student of science of our day knows that his belief is not atheism, but that it would be actual atheism *in him* to accept the finite deity believed in by the ignorant (a deity, to use Matthew Arnold's words, not less familiarly known than "some angry man in the next street") as truly representing the Infinite Power which resides in all things, and of which all phenomena are the unexplained and inexplicable manifestations.

Even Agnosticism, if it be interpreted to signify know-nothingism, is a most unsuitable word for the belief which recognises the Infinite as Unknowable. I am not concerned that Mr. Huxley may have expressed a certain modified approval of this term. Darwin differentiated Agnostic from Atheist by saying that Agnostic is merely Atheist writ respectable, and Atheist Agnostic writ aggressive. But the fact really is that science has been led to its present position by considering the known rather than the unknown, the knowable rather than the Unknowable. Science is able to say we *know* that Deity is not what the savage thinks and has thought it; we *know* that the wind and the storm, the earthquake and the volcano, plague and pestilence, sun, moon, and planets, are not as gods, knowing good and evil; we know even that the thoughts and emotions of man, his power of looking before and after, of distinguishing right from wrong, and of ruling his own nature accordingly—more and more perfectly as the race advances in development—only symbolise the qualities of the personality, if so one may describe it, of the Power working in and through all things. "That which wells up in us as consciousness" is doubtless a portion of "the power manifested throughout the universe distinguished as material"; and perhaps that which we recognise as conscience is a manifestation of the nature of the same power existing throughout the universe in its non-material aspect. It may well be that hereafter higher powers, as yet unimagined, may give us further symbolisations of that infinite power. But most assuredly the progress of science thus far has not been from recognition towards rejection of such a power, though at each step false ideas of Deity have been rejected as the mist through which they had loomed misshapen has cleared, until at last the purest conception of infinite power yet obtained by man has been reached. To those who see matters thus, the idea of Deity entertained by those who denounce the student of science as an atheist, appears truly atheistical—in this sense, that it presents to him, for adoration as Deity, the finite, the limited, the imperfect, nay, the evil, and even the horrible.

If we picture to ourselves the progress of men in this matter even until now, we may find it truly presented, as in a parable, in the vision of Elijah after his forty days' fast. The child-man of old recognised infinite power, transcending nature, when "the great and strong wind rent the mountains, and brake in pieces the rocks"—"but the Lord was not in the wind." And after the wind the powers of the earth's interior typified the Unknowable; "but the Lord was not in the earthquake." And then the sun and stars, with that earth-born child of the sun, Fire, appeared to men as the infinite power, working in and through all things; "but the Lord was not in the fire." And now in the workings of man's moral and emotional nature, the "still small voice" which tells us of something other than that material power whereof mere consciousness speaks, many recognise the manifestation of the Infinite. But God is not in the "still small voice"; that voice is in Him. Man does not feel the Godhead in him; he feels himself in the Godhead. He who thus thinks of Deity as absolutely infinite, yet as manifested in the finite, and rejects all such teachings about deity as falsely proclaim the infinite to *be* finite, and ascribe the same passions and the same weaknesses to Infinite Power which characterise us, the imperfect and the weak, may say with Elijah of old: We are "very jealous for the Lord"—our God—the Infinite Power working in and through all things. We do not denounce those whose ideas are less advanced—denunciation is for those of little faith—but we do proclaim, and as loudly as we may, that for *us* to teach as they do would not only be to offer to the Infinite "the unclean sacrifice of a lie," but would be nothing short of blasphemy.

THE WORSHIP OF THE PLANETS.

(*Continued from* p. 203.)

The offerings and sacrifices made by the Jews in old times on the Sabbath day and on the festival of the new moon (the beginnings of the months) show something, as I have said, of the nature of the observances prevalent among the Sabaistic nations from whom the Jewish sacrificial system was derived. We may with advantage consider what the injunctions addressed by the Jewish legislators to their people on these points really imply. No one who examines the matter reasoningly, and apart from preconceived prejudices, can fail to see that however suitable these observances doubtless were for nations regarding the sun, moon, and planets as real gods, not too far away to welcome with pleasure the smoke and smell through which the essence of the burnt offerings (their food) was absorbed by them, they would be absurd, even as symbolisations, for men recognising the heavenly bodies for what they are, and—above all—our earthly abode for what it actually is.

Thus run these ordinances, to regard which as divine would be blasphemy for any one who has formed other than such gross conceptions of Deity as suited perfectly the infancy of the human race:—

"And on the Sabbath day (ye shall offer) two he-lambs of the first year without blemish, and two tenth parts of an ephah of flour for a meal offering, mingled with oil, and the drink offering thereof; this is the burnt offering of every Sabbath, beside the continual burnt offering and the drink offering thereof."

"And in the beginnings of your months ye shall offer a burnt offering unto the Lord, two young bullocks and one ram, seven he-lambs without blemish; and three tenth parts of an ephah of fine flour for a meal offering, mingled with oil, for each bullock; and two tenth parts of fine flour for a meal offering, mingled with oil, for the one ram; and a several tenth part of fine flour mingled with oil for a meal offering, unto every lamb; for a burnt offering of a sweet savour, an offering made by fire, unto the Lord. And their drink offerings shall be half an hin of wine for a bullock, and the third part of an hin for the ram, and the fourth part of an hin for a lamb; this is the burnt offering of every month throughout the months of the year. And one he-goat for a sin offering unto the Lord; it shall be offered beside the continual burnt offering, and the drink offering thereof."

The rest on the day devoted to Saturn, and the idea that such rest could in any way delight the Infinite, must be regarded as in like manner belonging to the childhood of a race—in other words, to the era of semi-barbarism. The same race which could believe that their own particular god would take pleasure in seeing a people which, in its savage stage, was one of the most brutal and hateful this world has known, destroying and enslaving races not quite so barbaric and altogether less hateful than themselves, might well believe that that same God derived pleasure from their weekly rest—as indeed any respectable deity, or even Jupiter or Apollo, might very reasonably have done, seeing that whenever they were not at rest they were at mischief. But to attribute such ideas to an Infinite All-knowing Power would be simply blasphemous.*

The Jews, following the worshippers of the planets, believed also that yet more trifling ceremonies were of

* Perhaps the oddest notion of the early Jews was that Yahveh needed to be reminded by loud noise-making when He was to look after their interests during any of their abominable wars. "When ye go to war in your land against the adversary that oppresseth you, then ye shall sound an alarm with the trumpets, and ye shall be remembered before the Lord your God, and ye shall be saved from your enemies."—Numbers x. 9.

importance in the eyes of their God. "The Lord spake unto Moses" (so Moses said), "saying, Speak unto Aaron, and say unto him, when thou lightest the lamps, the seven lamps shall give light in front of the candlestick. . . . And this was the work of the candlestick, beaten work of gold — unto the base thereof, and unto the flowers thereof, it was beaten work. According unto the pattern which the Lord had showed Moses, so he made the candlestick"—that sevenfold candlestick by which the lights burning for the seven planets were originally supported.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By Edward Clodd.

VIII.—EXISTING LIFE-FORMS (*continued*).

A. *Plants.*

PLANTS are divided into two main groups or sub-kingdoms; I. Cryptogams (Gr. *kruptos*, hidden; *gamos*, marriage), or flowerless; II. Phanerogams (Gr. *phaneros*, open; *gamos*, marriage), or flowering.

I. The Cryptogams comprise as their leading representatives:—1. Algæ, Fungi, Lichens; 2. Liverworts, Mosses; 3. Ferns, Horsetails, Clubmosses. The feature common to these is the absence of any conspicuous organs, i.e. true flowers with stamens and pistils for the production of seeds or fruits. The simplest or single-celled plants increase by sub-division, each cell carrying on an independent life and repeating the process of division. But sexuality is manifest in plants very low down in the scale, the mode of reproduction varying a good deal in different species. In some cryptogams it is almost as complex as in the flowering plants, but notwithstanding the different kinds of sexual organs, there is this fundamental resemblance between them, that the union of the contents of two cells, a male or sperm-cell, and a female or germ-cell, each of which is by itself incapable of further development, is essential to the production of the embryo or seed.

The lowest cryptogams have no stems, leaves, or roots. They are congregations of simple fibreless cells united in rows, or gathered round one another, spreading on all sides. At the bottom of the scale of plant-life are the *Algæ*, comprising some 10,000 species, from the minute fresh-water desmids one-millionth of an inch in length, with their whip-like cilia the two hundredth millionth of an inch long, to the giant sea-weeds or tangles, hundreds of feet in length, that cover thousands of square miles of ocean. The green scum of stagnant ponds; the waving filaments in streams; the shell-coated microscopic diatoms that people the ocean, tinging its depths with olive-green, nourishing the whales that play therein, and whose skeletons form deposits hundreds of miles in length; the rose and purple weeds that flourish in shallow seas, and are cast upon their shores; are all members of a group which is perhaps the venerablest of living things. For although their generally fragile forms have been fatal to their preservation as fossils, there is little doubt that the algæ flourished in dense masses in primæval oceans, and were the chief, if not the sole, representatives of plant-life on the earth during millions of centuries. Like the foraminifera and other low animal organisms, they illustrate the persistency of the earlier forms, in virtue of their simplicity of structure, despite changing conditions, whereas the more complex structures, by reason of the greater delicacy of their parts, can less readily adapt themselves to altered surroundings, and therefore have a much narrower distribution both in time and space.

Next to the algæ in ascending order are those fantastic products of decay, the quick-growing, short-lived *Fungi*, animal-like in their mode of nutrition, plant-like in their fixity; then the *Lichens*, which, it is now generally agreed, are composite plants, being a special kind of parasitic fungi growing on algæ. These are widely spread, living, after the adaptive manner of simple forms, where nothing else can live, unwithered by the heat, unsmitten by the frost; redeeming the earth's desolate places, from treeless desert flats far as the lines of enduring snow; spreading their flowerless patches of richest colours in metallic-like stains over rock and ruin; encrusting the trees with tint of freshness or touch of age, with hoary fringe or mock hieroglyph; and in their decay yielding rich soil wherein fern and flowering tree may strike root.

In the *Mosses*, whose glossy, many-coloured masses weave softest carpet over the earth, sharing in the service rendered by the humble lichens, the cells have become more developed into rudimentary root, stem and leaf, manifesting still further transition towards unlikeness in parts due to division of function. But the structure is still cellular—i.e. there are no tissues and fibres. The mosses represent the intermediate forms between the lowest and the highest cryptogams, between the green algæ—out of which the liverworts were probably developed—and the ferns, which arose out of liverworts.

In the *Ferns*, the larger number of cells have joined together to form fibrous vessels, lengthening or thickening in varying shape and texture according to the functions to be discharged by them, resulting in the woody tissue which enters into the structure of all the higher plants. The cells, which are thus converted into tissue, cease to grow; the formative protoplasm becomes the formed, having given up its life for the plant, and locked up in the compacted material a store of energy for service both within the plant and by the agency of the plant. The ferns and clubmosses and horsetails of the present day are the dwarfed representatives of the stately and luxuriant, although sombre, flowerless trees that composed the dense jungles of green vegetation in the Devonian and succeeding Primary periods. These are distinguished as the Era of Fern Forests, during which our fossil fuel was chiefly formed; and although the palm-like vegetation of the tropics more nearly approaches its Devonian prototype, it falls far behind it in size and abundance.

II. The Phanerogams have their flowers with stamens and pistils conspicuous, and are divided, according to the formation of their seeds, into:

1. Gymnosperms, or naked-seeded, the ovules not being inclosed within a seed-vessel or ovary, but carried upon a cone, as in pines and allied species.

2. Angiosperms, or cover-seeded, the ovules being inclosed within an ovary.

This group is subdivided into (*a*) plants having one seed-leaf from which they are developed, as palms, lilies, orchids, grasses; and into (*b*) plants having two seed-leaves, as oaks, beeches, and all trees and shrubs not included in the foregoing species.

In naked-seeded plants the pollen or male element falls on the exposed ovules; in cover-seeded plants it falls on the stigma, passes down the pistil into the seed-vessel, and enters the ovule through an opening in it called the micropyle, or "little gate."

Whilst the gymnosperms are, on the one hand, most nearly allied in the order of descent to ferns, the sombre flowers which they bear giving them, only by strict botanical classification, a place among phanerogams, they are on the

other hand, more complex in structure than the single seed-leaf plants, because their bark, wood, and pith are clearly defined, as in the double seed-leaf plants. Their lowest representatives comprise the cycads or palm-ferns, so called from their resemblance to palms, for which, with their crown of feathery leaves, they are often mistaken. Next in order is the much more varied and widely distributed conifer family, notably pines, firs and larches, and, lesser in importance, cedars and cypresses. A still higher class, various in its modes of growth, marks the transition to angiosperms, the flowers of both having many features in common.

The single seed-leaf angiosperms have no visible separation of their woody stuff into bark, stem, and pith, and have no rings of growth, the wood exhibiting an even surface, dotted over with small dark points. Their leaves have parallel veins or "nerves," as in the onion and tulip, and the blossom-leaves, or petals, are grouped in threes or multiples of three. Among their several representatives we may single out the lilies for their beauty and fragrance, and the cereals for their value and importance, both classes being in near connexion, since the grasses from which man has developed wheat, barley, oats, rice, and maize are, in a botanical sense, degenerate descendants of the lily family.

The double seed-leaf plants include all the highest and most specialised varieties. Bark, stem, pith, and concentric rings of growth are clearly defined; the leaves are netted-veined, and the petals grouped in fours or fives or multiples of those numbers. The lowest class, represented by the catkin-bearers, as the birch and alder, the poplar and the oak; and by plants allied to the nettle and to the laurel, are nearly related to the highest gymnosperms. Next in order are the crown-bearers, or flowers with corollas, as the rose family, which includes most of our fruit-yielders, from strawberries to apples; while the highest and most perfect of all are plants in which the petals are united together in bell-shape or funnel fashion. Such are the convolvulus and honeysuckle, the olive and ash, and, at the top of the plant-scale, the family of which the daisy is the most familiar representative. Its position among plants corresponds to man's position among animals. As he, in virtue of being the most complex and highly specialised, is at their head, albeit many exceed him in bulk and strength, so is the daisy with its allies, for like reasons, above the giants of the forest.

The primary function for which the organs of plants known as flowers exist is not that which man has long assumed. He once thought that the earth was the centre of the universe, until astronomy dispelled the illusion, and there yet lingers in him an old Adam of conceit that everything on the earth has for its sole end and aim his advantage and service. Evolution will dispel that illusion. But our delight in the colours and perfumes of flowers will not be lessened, while wonder will have larger field for play in learning that the coloured leaves known as flowers, together with their scent and honey, have been developed in furtherance of nature's supreme aim—the preservation and increase of the species. And truly the contrivances to secure this which are manifest in plant-life are astounding, even to those who perceive most clearly the unity of function which connects the highest and lowest life-forms together. It is difficult, nay, well-nigh impossible, to deny the existence of a rudimentary consciousness in the efforts of certain plants to secure fertilisation. Take, for example, the well-known aquatic plant, *Vallisneria spiralis*. When the male flowers detach themselves and float about on the water, the female flowers develop long spiral stalks by which to reach them, and become fertilised by the discharge of pollen on their pistils. Most flowers have their male and female organs within the same petals, and in some cases fertilise themselves by scattering the pollen from the bursting stamens on the stigma or head of the pistil. But nature is opposed to this; "tells us in the most emphatic manner that she abhors perpetual self-fertilisation," with its resultant puny and feeble offspring; and we find a number of contrivances to prevent this, and to secure fertilisation by the pollen of another plant, to the abiding gain all round of the plant, whose blood, as we may say, is thus mixed with that of a stranger. Two agencies—insects and the wind—undesignedly effect this; while in the dispersion of the matured seed, birds and other animals play an important, although equally unconscious, part.

Plants which are wind-fertilised have no gaily-coloured petals or sepals, and do not secrete nectar. Such are the naked-seeded groups whose sombre flowers are borne on dull brown cones; and, among cover-seeded groups, grasses and rushes with their feathery flowers; and willows and birches, with their long waving clusters of catkins. All of these provide against the fitfulness of the wind, which is as likely to blow the pollen one way as another, by producing it in large quantities.

Plants which are insect-fertilised seek to attract their visitors by secreting honey and developing coloured floral organs. The way in which this came about is probably as follows.

The common idea about flowers is that they are made up of petals and sepals, whereas the *essential* parts are the stamens and pistils—i.e. the male, or pollen-producing organs, and the female, or seed-containing organs. The earliest flowers consisted of these alone, having no coloured whorl of petals within another coloured whorl of sepals, but were only scantily protected by leaves, as are many extant species. These the food-seeking insects then, as now, visited for the sake of the pollen, to the detriment of the plant, which lost the fertilising stuff and gained nothing in return. To arrest this, certain plants began, especially when in the act of flowering, to secrete honey and store it in glands or nectaries, or near their seed-vessels, where the insects could not get at it without covering their bodies with some of the pollen, which they rubbed on the pistils of the plant next visited, and thus fertilised the ovule, provided that the plants were nearly related. Honey is sweeter to the taste than pollen, and the plants that produced the most honey stood the better chance of visits from insects, and therefore of fertilisation, to the advantage of their species over others. As a rule, those which secrete honey have hairy coverings at the base of the petals, or other contrivances to prevent it being washed out by the rain or dew, or seized by useless insects, and we find curious interrelations established between plants and their desired visitors. Certain flowers adapt themselves to certain insects, and *vice versâ*, as where the plant has secreted the honey at the bottom of a long tube and the insect has developed a correspondingly long proboscis to gather it. By these and kindred devices the pollen is preserved for its sole function, the energy of the plant being conserved in the smaller quantity which it has to produce. As the honey was secreted as counter-attraction to the pollen, so the coloured floral envelopes were developed to attract the insects to the honey-secreting plant, and those floral whorls, both of petals and sepals, are modified or transformed stamens which have exchanged their function of pollen-producers for that of insect-allurers. And as both stamens and pistils are leaves aborted or modified for the special function of reproduction, Goethe's well-known generalisation that the leaf is the type of the plant has a large measure of truth in it.

But before speaking further about colour-development in plants, it may be useful to say a little about colour itself.

Since everything is black in the dark, and moreover has no colour in itself, it follows that colour is in some way a property of light. Now light, which is itself invisible, is due to vibrations or oscillations set up in all directions by any luminous body—whether the sun or a rushlight—in the ethereal medium which pervades all space, and is composed of rays of different refrangibilities—i.e. change of direction in passing from one medium into another. White light is due to the combination of all these rays, ranging through innumerable gradations of colour from red to violet, and it is to the absence of one or more of them that the infinite variety of colours is due. If a body is quite opaque, or otherwise so constituted as to absorb none of the rays, it appears white; if it absorbs them all it appears black; if it absorbs green, blue and violet, and not red, it appears red; if it absorbs red, orange, and violet, and returns or reflects green, it appears green. The colours which bodies reflect is therefore regulated by their structure; the way in which their molecules are arranged determines the number and character of the light vibrations or ether waves which are returned to the eye and which rule the colour we see—e.g. charcoal and the diamond are both pure carbon; the dull opacity of the one and the trembling splendour of the other are solely due to the arrangement of the several molecules of each.

It is thus obvious that any change in the nature or structure of a thing is accompanied by change in its colour, and to this cause the various pigments in plants is to be referred.

All growth involves expenditure of the energy which the plant has stored within itself, and which becomes active when the hydro-carbons combine with oxygen, resulting in cellular change, and appearance of other colours than the green, which is due to chlorophyll. Thus may be explained the colour of sprouting buds and young shoots and the more or less intensified colours of leaves and flowers—one and all due to oxidation, the minutest changes inducing subtle variations in colour.

Whichever plants made most show of colour would the sooner catch the eye of insects, however dim their perception of the difference in colours might be, and would thus get fertilised before plants which made less display. Thus have insects been the main cause in the propagation of flowering plants; the plants in return developing the colour-sense in insects. The flower nourishes the insect; the insect propagates the flower. Other contrivances to meet the need for fertilisation might be cited, as the markings upon the petals to guide the insect to the nectary; the exhalation of scent by inconspicuous flowers, or by such as would attract visitors at night, and so forth; but enough has been adduced to show what is the chief, if not the sole, function discharged by flowers—the attraction of insects to aid in securing cross-fertilisation. Nor does the provision stop here. The fertilised seed is not left to chance, but, like the fertilising pollen, is entrusted to secondary agents, to the care of the birds and the breezes. Where not scattered by the bursting of the ovary it is winged with gossamer shafts, as in the dandelion, and carried by the wind, floated on gentlest zephyr or rushing storm to a genial soil. Such wind-wafted seeds, like wind-fertilised flowers, are rarely coloured; neither are the seeds of the larger trees, since their abundance ensures notice by food-seeking animals; nor the nuts, which are protected by shelly coats. But other seeds enwrap themselves in sweet pulpy masses, called fruits, whose skins brighten as they ripen, and attract the eye of fruit-loving birds and beasts. The seeds pass through their stomachs undigested, and are scattered by them in their flight over wide areas. As with the brightest-hued and sweetest-scented flowers, so it is with the brightest and juiciest fruits; they sooner attract the visitors whose services they need, and thus gain advantage over less-favoured members of their species, developing by the selective action of their devourers into the finest and pulpiest kinds.

THE VELOCITY OF LIGHT.*

IN one of his early papers on "Optical Recreations" (volume v., p. 351), our contributor, "A Fellow of the Royal Astronomical Society," made cursory reference to the two methods adopted for the determination of the rate at which light travels, and expressed an opinion that the mode devised by Foucault was unquestionably the more trustworthy one. The fine volume before us contains an elaborately detailed description of the most recent application of Foucault's apparatus to the determination of the velocity of light, by Professor Newcomb and Professor Michelson in the United States, during the years 1880, 1881, and 1882; and it has seemed to us that, without encumbering our description with the minutiæ of optical and mechanical ingenuity and of the various corrections applied in reducing the observations, an account of the apparatus employed and of the mode of employing it, by these famous American observers, can scarcely fail to be instructive to all interested in the most refined of all physical measurements.

For the better apprehension of the nature of the work done by the two American professors, it will be better if, in the

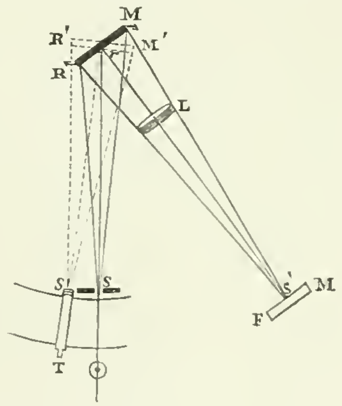


Fig. 1.

outset, we endeavour to render the principle on which their observations were made thoroughly intelligible. To this end we propose to describe the form of apparatus first used by Michelson, being a modification by him of that in which it was originally devised by Foucault; and we shall employ a diagrammatic illustration instead of an actual section or elevation of the arrangement employed, our object being just now to render the principle of the method intelligible. When we come to treat of the shape which the apparatus assumed in the hands of Newcomb, the reader will then be in a position to appreciate the use and significance of the various details. Turn we now to Fig. 1, where we are supposed to be looking down on to the top of Michelson's original form of apparatus. S is a slit with its length square to the surface of this page. Through it, reflected by a heliostat, passes the light from the sun ⊙, and falls upon a mirror R M, which turns round an

* Measures of the Velocity of Light, made under the direction of the Secretary of the Navy, during the years 1880–82, by Simon Newcomb, Professor, U.S. Navy. Vol. II. parts 3 and 4 of the Astronomical Papers prepared for the use of the American Ephemeris and Nautical Almanac: Washington, 1885.

axis in its own plane (also square to the paper) in the direction of the arrows. L is a long focus lens placed at its own focal distance from R M, and F M a very slightly concave mirror at a considerable distance (say a third of a mile or more) from the revolving one. Let us suppose the revolving mirror to be in the position shown at R M, then a study of the figure will show how the rays from the slit will fall on R M, be by it reflected on to the lens L, and being converged by that lens will form an image of the slit, say at s'. Then the mirror F M is fixed at s', so that its plane shall be at right angles to the axis $r s'$ of the pencil of reflected rays. Now suppose that $r s'$ falls on the lens L, then the light, after passing through the lens, will emerge parallel to r L, fall perpendicularly on F M, and be reflected back by precisely the same route that it came; and if we suppose R M to remain stationary during the interval, the image of the slit S will be reflected on to S itself, and would be in the middle of the field of a telescope placed immediately over S. We have said if R M remains stationary, but we may go farther than this and say that though the mirror R M be rotating rapidly, yet, if during the interval which is occupied by the light in getting from R M to F M and back, R M has not had time to alter its position sensibly, the image of S will equally coincide with the slit S itself. But now let us imagine that the mirror R M is spinning round at such a tremendous rate, in the direction of the arrows, that while it occupies the position R M when the ray starts for F M, by the time that ray gets back it has turned into the position R′ M′, then it will be seen that the image of S will no longer coincide with S itself, but will be reflected to S′, a point somewhere to the left of it (the angle S r S′ being obviously double that through which R M has turned), and if we want to see this image in our telescope we shall have to shift it from its position immediately over S to a new one S′ T. A glance at the figure will show that the distance we have to move our telescope will depend upon the rate at which the mirror is rotating, and on the time occupied by light in travelling from RM to FM and back again. A little very rudimentary mathematics will now enable us to calculate the velocity of light. We measure first SS′ the displacement of the image of S, or the distance through which we have to move our telescope; then the distances S,r and r,s', and finally the number of turns per second that our mirror RM is making. Call SS′,d, Sr = a, r,s' = c. V = the velocity of light; t = time occupied by light in travelling from r to s' and back again. θ = the angle turned through by RM in time t and N = the number of times RM rotates in one second.

In one second RM turns through an angle of 2πN : so that in t seconds it will turn through $2\pi Nt$, hence $\theta = 2\pi Nt$.

Now in turning through this angle θ, the mirror has changed the position of the reflected ray from rS to rS′. Therefore the angle SrS′ $= 2\theta$. Further SS′ = Sr tan SrS′ $= a \tan 2\theta$. So that S,S′ (our d) $= a \tan 4\pi Nt$. t, though, is the time occupied by the light in going from r to s' and coming back again: whence $t = \frac{2c}{V}$ and $d = a \tan \frac{8\pi Nc}{V}$.

As this angle 2θ is necessarily very small, we may for our purpose use 2θ for tan 2θ, and say $d = \frac{a \times 8\pi Nc}{V}$ or $V = \frac{8\pi Nac}{d}$. In Michelson's original experiments the centre r of the rotating mirror RM was 28·14 feet from the slit S; i.e. $a = 28{\cdot}14$ feet. The distance r,s between the centres of the mirrors RM and FM was 661·49 yards; i.e. $c = 661{\cdot}49$ yards. The distance SS′ was 4·45 inches; i.e. $d = 4{\cdot}45$ inches, and the mirror RM rotated 257 times per second, or N = 257 nearly. If we substitute these quantities in the formula above, we shall find as the resulting velocity of light 184,238 miles per second.

Should the reader fail to grasp the principle of this method, he is earnestly urged to re-peruse, step by step, the explanation given above. When the idea is once grasped, the succeeding description of Professor Newcomb's refined apparatus and methods of observation should present no difficulty whatever.

Let us see what are the essential conditions of construction of the apparatus. First, then, we cannot deal with a ray of ordinary light as a mathematical line, so that a lens, or system of lenses, becomes imperative; and confining ourselves for the time being to a single lens, if we are going to observe a luminous slit, then this slit and the (fixed) concave mirror must be in the conjugate foci of our lens, and the rotating mirror must be in the path of the ray. This lens must, *ex necessitate*, be either between the slit and the revolving mirror, or between the revolving mirror and the distant one. In the former case, however, we are met by the objection that only very small deviations can be accurately measured, as a wide one would send the return ray through a different part of the lens from the out-going ray, and so render measurement very uncertain. Now it must be quite evident that our object is to make the angle to be measured (SrS′ in fig. I) as large as possible. This means, in practice, that either the slit S, or the fixed concave mirror FM, shall be as far as possible from the rotating mirror. There are numerous objections to removing the slit to any considerable distance, hence in practice it is the fixed mirror which is placed as far as possible from the rotating one. But here again we are met with a difficulty. When the image of the slit is returned and reflected from the rapidly turning mirror, its brilliancy is diminished in the ratio of the diameter of the fixed mirror to the circumference of the circle whose radius is the distance of that mirror from the revolving one. Moreover, in traversing a great distance, reflection, absorption, and dispersion, will all cause further loss of light; so that we require some arrangement that shall render the feeblest return ray visible; in other words we want our field of view as dark as possible.

Now the first device employed by Professor Newcomb for this purpose was to employ two telescopes—one for sending the ray out, and the other for receiving the return flash. In order that the two reflections, however, should take place from the same part of the rotating mirror, these two telescopes would require to be in the same horizontal plane. But it is abundantly obvious that no small deviations could possibly have been measured with this arrangement, as the two telescopes would have been in one another's way. It was, moreover, found that, in addition to this drawback, the quantity of light irregularly reflected from the mirror when the sun shone upon it inconveniently illuminated the field of view. Hence the telescopes were placed one above another, and the mirror elongated sufficiently to receive the rays from each telescope. As we shall presently see, the rotating mirror was capable of being turned in either direction, so that measurements of deviation could be made, so to speak, both to the right and left of the slit. Hence all uncertainty as to measurement from a zero point was eliminated. Reverting now to the subject of the darkening of the field of view so as to render the faint reflected image of the slit conspicuous, we may briefly say that the whole apparatus was contained in a dark room in which there were only two openings, one for admitting the light from the heliostat to the slit, and the second for sending and receiving the reflected light. This light came through a small opening in a blackened box some fifty yards distant in the path of the ray. The result of the whole arrangement was that just enough diffused light entered the receiving telescope to

render the spider line in the eye-piece visible. Bright wires would have been needed with any fainter light than this. The rotating mirror was most ingenious, and Professor Newcomb expresses his obligation to Professor H. A. Rowland, of Baltimore, for the valuable aid he rendered in devising it. It consisted of a solid rectangular steel prism with carefully ground and polished sides. To the top and bottom of this were fastened pairs of circular plates, each pair holding a set of twelve fans, upon which an air-blast impinged. The top and bottom of the axes of the mirror terminated in slightly conical pivots, the surface of the bottom one being very nearly flat and about ·08 inch in diameter. This rested on a diamond. By an elaborate system of air-pipes the observer could cause this mirror to rotate either to the right or to the left, and by opening slightly the bottom apertures, when the air-blast rotating the mirror was entering by the top set, and *vice versâ*, could regulate the rate of its motion to a nicety. The number of complete rotations performed in a second was measured by fixing a pinion of sixteen teeth round the upper axis of the mirror. This geared into a wheel with sixty-four teeth, as did that, in turn, by a ten-tooth pinion into a wheel of seventy teeth, so that the latter turned once for every twenty-eight times that the mirror did. A knob in this last wheel at every revolution touched a spring which formed part of an electric circuit passing through a standard, so that circuit was broken once in every twenty-eight turns of the mirror. A cylinder chronograph was caused to perform one revolution in ten seconds. Its pen was connected with a closed circuit, passing through a break-circuit chronometer and through the spring just spoken of. Thus two series of indentations appeared in the line marked by the pen on the chronograph, the one at intervals of a second and the other at the intervals in which the mirror performed twenty-eight revolutions. A curious thing happened in connection with this recording apparatus. After a few days' trial it was found that the wheel work was entirely destroyed by the rapid rotation to which it was subjected. New wheels wore out before it was practicable to obtain a set of readings! In this extremity Professor Newcomb returned the apparatus to its makers, Messrs. Clark and Sons, and they hit upon the ingenious device of employing raw hide for the first wheel, with entire success. The position of the receiving telescope was read off upon an arc, whose centre lay in the prolongation of the vertical axis of the rotating mirror, such reading being made by suitable reading microscopes attached to the horizontal frame carrying the receiving telescope. The eye-end of the telescope itself carried a micrometer. A little thought will suffice to show that, as the transmitting telescope must send its rays approximately in the same direction as that from which they are received, if the two telescopes were directly over each other the slit end of the transmitting one would be right in the way of the observer. This difficulty was overcome by the simple expedient of bending the transmitting telescope at a right angle, and putting a diagonal mirror at the bend to reflect the light from the slit through the object glass. All this will be rendered intelligible by reference to fig. 2.

F is the sending telescope. The light of the sun is sent by a heliostat through the slit S, passes down the tube and is reflected by the diagonal mirror through the object-glass J. *m* is the revolving mirror receiving this light and reflecting it along Z to the distant fixed mirror (not shown). M,M,M,M a stiff frame screwed into stone caps on the brick piers P,P′ with a horizontal divided arc on it at A. L the receiving telescope with its objective immediately below J, mounted on adjustable Y's on the frame N which turns horizontally round a vertical axis coincident with that of *m*. Its extreme range of motion is about 8°. The apparatus through which the air-blasts pass to turn the mirror *m* is omitted, as it is somewhat too complicated to be shown on the small scale of our drawing.

The measurements were performed by Professors Newcomb and Michelson, and by Ensign Holcombe, U.S.N. The stations were selected on the opposite sides of the Potomac river; the telescopes and rotating mirror being erected in Fort Myer, on the Virginia side of the river, overlooking the city of Washington. In the first instance the fixed mirror was placed in the grounds of the Naval Observatory; but, it being subsequently found that observations could be made at a greater distance, this mirror was removed to a point at the base of the Washington Monument. In the first case the total distance between the mirrors was 1·585

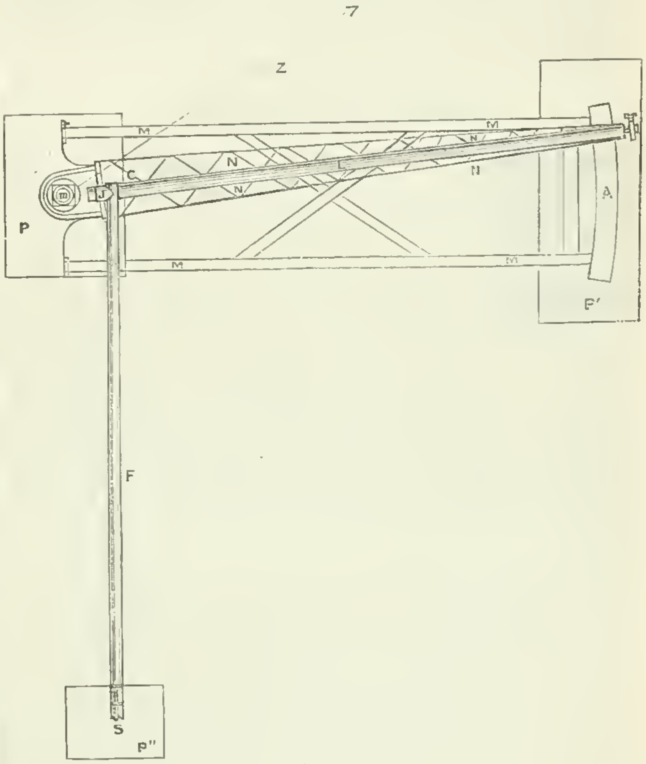


Fig 2.

mile; in the second 2·312 miles; the light, going and returning, of course, travelling over double these distances respectively. What we have called the fixed mirror was really two mirrors of $15\frac{3}{4}$ inches in diameter, placed side by side. Their radius of curvature was something like 1·86 mile.

As the result of a most elaborate and exhaustive series of observations with this beautiful apparatus, Professor Newcomb finally deduced as the velocity of light in vacuo 186,326±25 miles per second. It will interest the astronomer to derive the solar parallax from this determination, in combination with the now generally accepted constant of aberration (that of Nyrén) 20″·492, and Colonel Clarke's computed equatorial radius of the earth, 3963·296 miles. It will be found to be 8″·794, corresponding to a mean distance of the earth from the sun of 92,959,200 miles.

At Professor Newcomb's request, Professor Michelson subsequently repeated his own determination of the velocity of light by the method originally employed by him. As a final result he obtained 186,322±37 miles per second as the rate at which light travels in vacuo, an approximation surprisingly close to that of Professor Newcomb, when we

consider the extraordinarily delicate character of the investigation. Moreover, Professors Newcomb and Michelson in the course of their most recent series of observations, were enabled to set at rest a curious discussion started in 1880–81 by Professors Young and Forbes; who, employing a modification of Fizeau's toothed-wheeled apparatus, got the fancy into their heads that light of different refrangibilities (or colours) travelled at different rates. Were this true, of course a star like Algol would show marked chromatic phenomena during its increase and decrease, which it notoriously does not. Also a well marked iridescence of the edges of the return image of the slit must be perceptible in the apparatus which we have been endeavouring to describe; while as a matter of fact, though most carefully looked for, nothing whatever of the kind could ever be perceived.

SCIENCE AND POLITICS.

MANY daily papers were indignant with Professor Huxley for expressing an opinion about the Irish question and politics generally. Other papers in which views akin to those adopted by Huxley have been expressed found his support encouraging, and therefore regarded his expression of opinion with approval. It might be interesting to inquire whether the former really objected to a student of science expressing an opinion *at all*, or only to the fact that the opinion about the Irish question which this particular student of science had expressed chanced to be adverse to that adopted in their columns. Be this as it may, they definitely laid down the opinion that a student of science is going "outside his depth" in talking about such matters at all.

Let us consider if there are any valid reasons for thus putting the student of science outside the pale of politics.

In our country we have in theory democratic government. In practice the theory may be a little diluted. Yet even in practice we find all classes possessing influence, almost every man who has any stake whatever voting, all men free to express their views as loudly as they please. We find our House of Commons composed of men of all orders in the community, except clergymen, who are manifestly not well fitted for political life. If a man who has passed all his life in banking business, or in legal practice, or in manufacture, trade, or commerce, takes it into his head to seek for admission into Parliament, no one proclaims that he is "out of his depth" in talking about political matters, though mere election to the House of Commons is not an equivalent for political education. But outside Parliament, men whose lives have been passed in pursuits in no way connected with politics are listened to with attention. Is there anything in the study of science which should prevent a man from forming a just opinion on political matters, any more than there is in the study of the money market and City intelligence?

It may be urged, perhaps, that men of science are very apt to be, or to appear, so engrossed in their own special and appropriate pursuits, that they seem to care little about political matters. But it ought to be regarded as at least possible that in this customary silence about matters in regard to which the most ignorant and foolish are always ready to proclaim their contradictory notions, the student of science shows not only more sense, but even that he has studied political matters more closely than the noisy herd who are always talking about them.

As a mere matter of fact, nothing seems to the student of science much more absurd than the careless haste with which the average mind proclaims its views on matters of the profoundest difficulty. It appears to matter nothing to Tom, Dick, and Harry that they know nothing or less than nothing (for wrong ideas are worse than none) about a political question which troubles the country and perplexes the most thoughtful minds and the most carefully trained politicians. Tom is not concerned because Dick differs from him, or because Harry agrees with neither. Nor are any of the three, or the classes they represent, troubled because in former times they expressed quite different views, or because their actual views, the product of a day, are likely to last but for an hour. They are as dogmatic and as positive as if they had absolute certainty, where in reality their ideas have no more stability than the waves of a storm-tossed sea.

And this applies to the average body in Parliament as well as to the average body in the community. It appears to outsiders as if members of Parliament were devoting so much time and attention to legislative and political matters that they must necessarily be fitter to decide about matters affecting the community and the nation than those who elected them and sent them to work for them (as they suppose). But about the only matters in which the average member of Parliament is more experienced than the average merchant or tradesman are those relating to Parliamentary procedure, and there is nothing in these by which statesmanship or legislative skill may be fostered. Indeed, it is commonly noted that those members of Parliament who are sharpest about matters of procedure are the least capable in regard to higher matters.

Now, the student of science has at least one immense advantage over average men whose avocations are unscientific. His training requires that he should constantly consider cause and effect, the action and operation of law. It is here that your average politician, and many, indeed, who are somewhat above the average, are weakest. They are always being led astray by the mistake of confounding mere sequence with causal influence, or, in technical terms, they are constantly misled by the *post hoc ergo propter hoc* fallacy. Nine-tenths of the legislation of the present reign, for instance, has been affected by this fallacy, as its consequences have shown. The very multiplicity of the law-making experiences of our Parliaments attests the blundering capabilities of our legislators; for nine-tenths of their work is directed to the repairing of previous mistakes.

Then, again, there is another most important advantage which the mind trained in scientific pursuits has over minds otherwise exercised. The student of science is constantly taught the necessity of cautious and repeated inquiries into the validity of evidence or of reasoning which to the unscientific mind would appear absolutely and overwhelmingly decisive. We have only to compare the student of science of to-day with his predecessor in past ages to see how wonderfully scientific caution has developed, even while scientific daring has increased in as marvellous degree.

In old times men calmly advanced such explanations as the more obvious evidence seemed to them to suggest, and seem never to have been troubled with a trace of doubt. If rain fell, "the floodgates of heaven" had been "opened"; if the sun rules the seasons, and the moon measures time, the sun and moon were made—and the stars also—to *be* for signs and seasons, and for days and years; if the hare seems to work its lips like a ruminating animal, the hare is immediately classed among creatures which chew the cud; and so with a hundred seemingly obvious facts which are now known to be perfectly obvious blunders. But now the student of science—who, if he is wise, no longer calls himself a man of science—questions all that seems most

obvious, doubts even all theories which seem most thoroughly established. The rain which seems to come from the skies, which had been traced to the clouds, and thence to unseen pure transparent vapour, he traces yet farther back by circuitous aerial courses to other regions, and thence to the sea, while he finds as the actual cause of rain that which to the ancients seemed the great opponent of rain, the destroyer of the clouds—the might and glory of the sun. And so, in all matters which the man of science of old explained simply and easily, the modern student of science weighs and balances and doubts, till at last he is able to show *how*, but modestly admits that he cannot explain *why*, the so simply explained because so thoroughly misunderstood phenomena take place.

Now, neither the constant study of cause and effect in physical or mental phenomena, nor the development of a habit of most cautiously dealing with all evidence obtainable, can fit the student of science to express an opinion on some political or legislative matter into which he has not made careful and special inquiry. If a Darwin or a Newton, departing from his natural or acquired character, were to undertake to decide on a point of statesmanship or of religion, in which he admitted that he had taken no special interest, and about which he had made no investigations, his opinion would deserve no more respect (but, be it noticed, it would deserve no less) than that of a merchant or a landowner, who had managed to get into Parliament, and had there supplemented his commercial or agricultural experience by more or less careful study of Parliamentary procedure. The former would be forgetting the lessons of his scientific life, forsaking the advantage of his scientific training—and would, almost certainly, fall into some gross blunder. But the latter is falling into such blunders all the time; and the student of science is among the innocent members of the social body who have to pay for such blundering—and a tolerably heavy price we pay, too.

If a man of approved scientific powers, however, trained to cautious study of carefully accumulated evidence, speaks about a political or a religious matter with some degree of confidence, it may be usually taken for granted that he *has* given the matter careful attention—simply because it would be running counter to the whole spirit of his career to speak in that manner of a matter that he had not studied. For this reason, I should myself attach very much greater weight to the definitely expressed opinion of a Tyndall or a Stokes, a Huxley or a Spencer—of any scientific man, in fact, *not* a specialist (specialists being mostly narrow-minded)—about any political or religious matter, than I would to the opinion of a politician or a priest. For while I should feel well assured that the man of science must have studied the subject or he would not speak about it (the chances being rather the other way with the politician and the priest), I should know that his study of the subject, checked by the scientific habit of cautious and law-seeking inquiry, would be bound to be much more satisfactory than that made by men less cognisant of the necessity for studying causal relations and for exercising constant caution.

Unfortunately, students of science very seldom do express an opinion about political or religious matters—which is another way of saying that they seldom make political or religious matters the subject of inquiry. When they do, the unscientific necessarily imagine they are going beyond their depth. But in reality, the student of science recognises how thoroughly the ordinary politician goes outside his depth in nearly all that he undertakes to discuss or deal with. Mr. Herbert Spencer has well shown in the introductory pages of his "Sociology" the absurdity of the calm security, the overweening self-confidence, with which the average politician (who generally knows nothing about politics beyond its vocabulary—which is naught) undertakes to make and alter laws for regulating relations far more complex than those with which the student of science ordinarily deals.

As for Professor Huxley's remarks, if he was out of his depth in making them, it must be assumed that the student of science may only enter very shallow waters indeed. This is by no means saying that I agree with him (it chances, indeed, that I do not), only that I think he has at least as good a right to form and formulate an opinion as the average member of Parliament, or even the editors of the daily papers and the "young buccaneers of the press" over whom they hold command. Any one who knows how and by whom newspaper articles are written must smile at the weight which the average reader of newspapers attaches to their trivial utterances. Even as one who has studied our universities smiles when he sees men and women—aye, the aged and experienced—moved by the commonplace teachings of men who till a year or so before had "vexed the souls of deans" (and barely escaped plucking in mild examinations because of their undue devotion to boating and cricket, cards and billiards), so must we smile, though with a touch of sadness, to see the business men of a nation accepting the political teachings of half-fledged youngsters, failures in their selected professions, writing at the order of men who know even less than themselves about politics or statecraft. Yet the confident air of these weaklings, the energy of their assumed enthusiasm, and the violence of their party zeal, produce far more impression on the many than the well-weighed and therefore cautious opinions of the thoughtful student of political and sociological history.

Professor Huxley has simply pointed out that our leading politicians ought to lead, not to be led; that trying to find out what is the average opinion of the nation, the opinion held by the greatest number not by the best quality, and then following that opinion, is a course likely to result in no great achievements. He has expressed admiration for Mr. Parnell as leading, not being led, but not for Mr. Parnell's views—the success of which, he thinks, will be Mr. Parnell's ruin. And if he has expressed his objection to Home Rule, in which certainly he is not particularly original, he is modest enough in his ideas not to point out the course along which he would like to see some statesman guiding the country.

But to some half-trained leader-writer in a daily paper, who would treat with respect the utterances of a man whose whole life had been passed in huckstering on a rather large scale, the opinion of a keen and earnest thinker, trained to careful reasoning and to caution in forming an opinion, appears—so ignorant is he—as floundering no worthier of respect than he knows his own ideas to be.

In this country, as in America, we need the well-weighed thoughts of the minds which recognise law and causation; we have long had much more than enough of the utterances of those who recognise only luck and sequence, whose legislative measures have as much real relation to the needs of the nation as the thrice turning of a gambler's chair or a change of the pack he plays with has to the success of his play.—*Newcastle Weekly Chronicle.*

Approaching Extinction of the Lion.—When we hear that the lion of the desert is threatened with extinction, we cannot regret the circumstance, king though he be of animals. Sportsmen and zoologists may lament, but others cannot, when we hear that the Government of Algeria is paying a high premium (2*l.* a head) for lions killed in that country, and that within the last eleven years a sum of 400*l.* has been paid in this way, telling of 200 lions destroyed. The lion of the desert is, in fact, becoming a thing of the past.—*Newcastle Weekly Chronicle.*

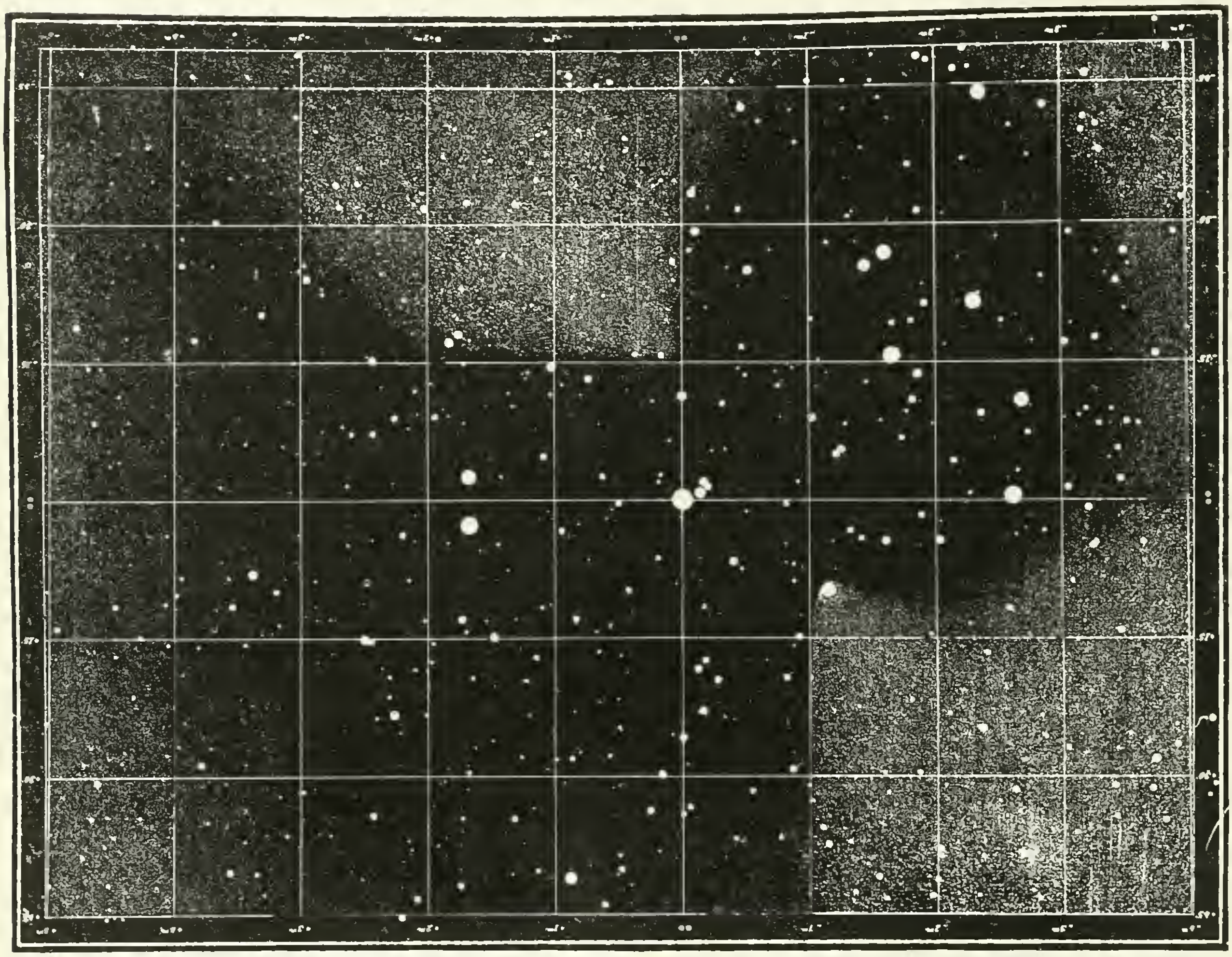


Fig. 1.—Chart of the Pleiades, drawn by M. Wolf in 1874, at the Paris Observatory.
(This chart, prepared for the observatory, is here purposely inverted to show the Pleiades as presented in the small chart, fig. 3.)

FIG. 2.—PHOTOGRAPH OF THE PLEIADES, BY THE BROTHERS HENRY.
Three Exposures, each of one hour.

THE PLEIADES PHOTOGRAPHED.

THE accompanying views of the Pleiades enable us to compare the work of the telescope and the human eye (fig. 1) with the work of the photographic eye (fig. 2).

In fig. 1, the star Alcyone is taken as the central point from which ascension and declination are measured, the plus sign indicating, of course, declination north of Alcyone and increase of right ascension. One of the nebulosities in this map extends from Merope southwards and westwards, and around the Pleiades northwards. The other extends northwards from Pleione. But although M. Wolf, to whom this map is due, indicates this enormous extension of both nebulosities, there is in truth little authority for it.

In fig. 2, we have the result of photography alone. The nebulosity from Merope is shown with much less extension than in fig. 1, but with indications of detail such as M. Wolf's drawing does not present. The chief interest of this photographic view, however, resides in the nebulous extension from Maia, which had never been detected by human eye.

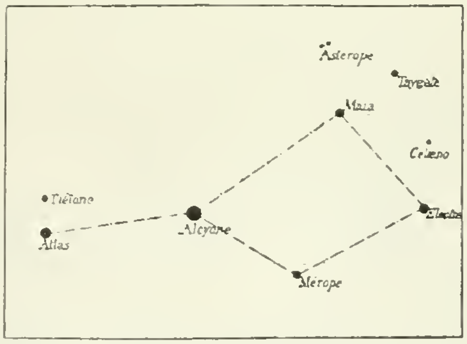


FIG. 3.—CHART OF THE NINE CHIEF STARS OF THE PLEIADES CLUSTER.

Fig. 3 is added to enable the student to identify the leading stars of the group. All three figures are from M. Flammarion's *Revue d'Astronomie.*

Next month we propose to consider the significance of the nebulosities in the Pleiades, as throwing important light on the structure of the stellar universe. An enlarged view of the nebula around Maia will then be given.

INDIAN MYTHS.

By "STELLA OCCIDENS."

. . . slow, ascending one by one,
The kindling constellations shone.
Begirt with many a blazing star,
Stood the great giant Algebar,
Orion, hunter of the beast!
His sword hung gleaming by his side,
And, on his arm the lion's hide
Scattered across the midnight air
The golden radiance of its hair.

LONGFELLOW.

WE have become acquainted with some of the Indian Myths about the sun, the moon, and the Milky Way, and now we must turn our attention to the constellations. These groupings of brilliant stars suggested to the vivid imagination of the Indian many fanciful stories, which, however, are not as superficial as they may appear. If we could understand their thoughts we could trace some reason for these myths, which are founded on the everyday experiences of these savage races. According to the Iroquois traditions the stars were supposed to be the souls of departed warriors, or favoured animals and birds. The constellations were thought to be groups of especially favoured mortals, the constellation Orion being that of an intrepid hunter of enormous size. The Eskimos believe that the stars in his belt are seal-hunters who missed their way, and they call them the Lost Ones. The Iroquois believe that these bright stars are brothers, who left their home, where they had been badly treated. They were pursued by their parents, who have been ceaselessly chasing them.*

The Iroquois tribe have an interesting story with regard to the group of stars known as the Pleiades, or Dancers. They believe that it is a group of seven little Indian boys. The latter were in the habit of eating their supper of corn and beans every evening on a little mound. After they had eaten, the sweetest singer would sit on the top of the mound and sing for his playmates, whilst they would dance around him. One day they resolved to have a great feast, but unfortunately the parents refused to supply the food, so the seven little Indians resolved to have a feastless dance. As they flew round the mound to the sweet, enchanting strains of the singer, their heads and their hearts grew lighter. Suddenly the whole party whirled off into the air, and the inconsolable parents called after them in vain. They arose higher and higher, whirling around their singer until at last they reached the sky. Here they were changed into bright stars, and as the Pleiades they are dancing still. The singer, on account of his desiring to return to the earth, was not as brilliant as the rest.†

In the Northern hemisphere there is a group of stars which the Odjibwas call Ojeeg Annung, or the Fisher stars. They are supposed to be the same as the group of the Plough, and the following tale is related respecting this constellation:—

Once there lived a celebrated hunter on the shores of Lake Superior who was so successful in the chase that he was considered by some to be a Manito. His name was Ojeeg Annung, or the Fisher, and was that of a sprightly little animal common in that region. He lived in a wild, lonely wood with his wife and his little son. The latter wished to be a great hunter like his father, and tried his skill on birds and squirrels. The only difficulty in his way was the extreme cold; his little hands would often be frostbitten, and he would run home complaining to his mother. One day, when he was returning with a heavy heart, he saw a small red squirrel gnawing the top of a pine bur. He approached near enough to shoot him, when the squirrel sat up on his hind legs and thus addressed him:—

"My grandchild, put up your arrows, and listen to what I have to tell you." The boy obeyed somewhat reluctantly, and the squirrel gave him the following advice. He promised the boy perpetual summer and the pleasure of killing as many birds as he pleased if he would do as he directed. He told the boy to cry bitterly, and complain of the cold when he reached home and refuse to eat anything. "This will naturally arouse your father's curiosity, who will ask the cause of your grief. Tell him, then, that seeing the snow always on the ground troubles you, and ask him if he is not powerful enough to make it perpetual summer. He will tell you to be still, and cease crying, and he will try to bring summer for you. You must then be quiet, and eat what is placed before you."

The boy did as he was told, and all came true. The father had a great feast, to which he invited some of his friends, who then accompanied him on his journey. After twenty days they arrived at the foot of a high mountain; here they followed a track which led them to a hollow in the mountain. Ojeeg warned his friends not to laugh on any account, for they were about to see the great Manito, who was deformed. His head was enormously large; he had a queer set of teeth, and no arms, and his movements were so awkward that the Otter laughed as soon as he saw him. The Manito sprang at him, but the Otter escaped, and was soon rejoined by his friends, who had brought some meat for him.

When the party reached the top of the mountain they were very high up, and they all made attempts to try and make a hole in the sky.

All failed except Wolverine, who after the third attempt succeeded in making a hole, and the Fisher quickly followed.

They found themselves in a beautiful plain, and the trees were alive with birds of different plumage, warbling their sweet notes, and delighted with perpetual spring. Fisher, seeing some birds in cages, let them out, and they escaped through the opening in the sky. When the celestial inhabitants saw the birds let loose, and the warm gales descending on the earth, they ran to their lodges. It was too late. Spring, summer, and autumn had gone; even perpetual summer had almost gone. They separated it with a blow, and only a part descended. Wolverine, hearing the noise, escaped through the hole in the sky; but the Fisher was too late, and, being pursued, he was hit at last by an arrow near the tip of his tail. This was the only vulnerable spot in his body, and, after a vain attempt to descend to earth, he laid himself down to die. He said: "I have fulfilled my promise to my son, though it cost me my life; but I die satisfied in the idea that I have done so much good, not only for him, but for my fellow-beings. Hereafter I will be a sign to the inhabitants of the earth, who will venerate my name for having succeeded in procuring the varying seasons. They will now have from eight to ten months without snow."

Next morning he was found dead with the arrow sticking in his tail, as it can be plainly seen at this time, in the heavens.*

The constellation of the Great Bear has given rise to curious myths. Flammarion, in his "Astronomical Myths," in the chapter on the origin of constellations, remarks that "the Iroquois, when America was discovered, called it Okouari, their name for a bear. The explanation of this

* "Myths and Dreams." Clodd, p. 30.

† "Bureau of Ethnology," 1880–81, p. 80. Smithsonian Institute.

* Schoolcraft, "Hiawatha Legends," p. 121.

name is certainly not to be found in the resemblance of the constellation to the animal." * The Iroquois tradition, however, accounts for its name in the following way: "A party of hunters were once in pursuit of a bear, when they were attacked by a monster stone giant, and all but three destroyed. The three, together with the bear, were carried by invisible spirits up into the sky, where the bear can still be seen, pursued by the first hunter with his bow, the second who bears a kettle, and the third, who, farther behind, is gathering sticks. Only in the fall do the arrows of the hunter pierce the bear, when his dripping blood tinges the autumn foliage. Then for a time he is invisible, but afterwards reappears." †

This same belief existed among the Algonquin Indians of New England, and is related in a poem, of which the following is a translation:

We are the stars which sing,
We sing with our light;
We are the birds of fire,
We fly over the sky.
Our light is a voice;
We make a road for spirits,
For the spirits to pass over.
Among us are three hunters
Who chase a bear;
There never was a time
When they were not hunting,
We look down on the mountains.
This is the Song of the Stars. ‡

DID BIRDS OR BEASTS COME FIRST?

NOTE RESPECTING CERTAIN AFFIRMATIONS, ANCIENT AND RECENT, CONCERNING THE QUESTION OF MAMMALIAN JUNIORITY.

By OSWALD DAWSON.

IN the March issue of KNOWLEDGE, Mr. Edward Clodd is printed as affirming that birds "certainly preceded mammals in the succession of species." As it happens that the claims to seniority of the air-population and land-population has been a topic of extreme interest throughout England and elsewhere since the publication of Mr. Gladstone's "Dawn of Creation and of Worship" in the *Nineteenth Century* of last November, and since Prof. Huxley allowed Mr. Gladstone's statement that the juniority of mammals was a "demonstrated conclusion and established fact" to pass unchallenged, § I shall presume to question this alleged "certainty."

When finding Prof. H. G. Seeley affirm that "geological history does not carry us back appreciably towards the origin of the great divisions of organic nature—there is evolution, but it is only the evolution of genera and of ordinal groups and not of classes" (pp. 451, 526, of "Manual of Geology"), one is tempted to suppose that considerations other than those derived from palæontology have prompted Mr. Clodd's declaration. Yet what can such considerations be? No one imagines that the *Monotremata* are indebted for their ornithic or sauropsidan characters to inheritance from birds. Birds are not more highly organised than mammals, thus favouring a presumption that their evolution must have commenced earlier. More multitudinous in specific forms than mammals birds may be, but did this indicate a higher antiquity, its weight would speedily be more than neutralised by a reference to the notorious homogeneity of the class *Aves* in comparison with the class *Mammalia*, or, indeed, with the *Ungulata*, e.g., alone.

Mr. Clodd makes the singular remark that, "in the absence of proof that" certain Triassic footprints "are due to birds, which certainly preceded mammals in the succession of species, a great link is missing in the Trias, since that system has yielded teeth of the earliest known mammal." Truly "a great link is missing," if what is sought be an iota of warrant for the assumption that birds certainly preceded mammals; but otherwise no link, great or small, is missing. Even were the Connecticut prints proven to be avian, the seniority of birds would only be established by assuming that the beasts of the upper Trias exhibited to us the dawn of mammalian life, and then the seniority would be won by less than a period. But it is generally admitted that the *Monotremata* are the nearest representatives of the primordial *Mammalia*, justifying Professor Huxley's designation of *Prototheria*; * whereas *Microlestes* &c. are affiliated to one or other of the Marsupial, or, it may be, Eutherian groups.

The post-Amphibian ancestors of the *Mammalia* are not known. They are termed *Hypotheria*. Though the Thuringian lizard of the Permian occupies an exalted position in Professor Haeckel's "Twenty-two Ancestral Stages of Man," and though we have "theriodont" and otherwise theriomorphic fossil reptiles, it nevertheless remains improbable that any reptile has intruded into mammalian phylogeny. But even were the contrary view proven, a post-Palæozoic origin of mammals would by no means be involved in the circumstance. I commend those who fancy otherwise to Prof. Huxley's criticism of Prof. Haeckel's "Ante-Triassic" &c. periods ("Critiques and Addresses," pp. 310–312). The illustrious critic would "put the existence of the common stock" of reptiles "far back in the Palæozoic epoch;" and, having mentioned that "*Mammalia* certainly" existed in the Triassic age, concludes with the sound remark: "I should apply a similar argumentation to all other groups of animals" besides reptiles. Prof. Flower, too, finds it "reasonable to conclude" that *Prototheria*, *Metatheria*, "*and perhaps* Eutheria" existed "*far back in the Mesozoic age*" ("Osteology of the Mammalia," third ed., p. 5). One of the latest authorities, or, at any rate, authors, the late Prof. Oscar Schmidt, in his "Mammalia in their relation to Primæval Times," gives us no clue as to the relation of the *Prototheria* to primeval times. This writer (on p. 253) states that "the vertebræ of whales have even been found in the Jura." † Additional evidence could be cited, were it needful, to justify a belief in the antiquity of beasts.

However, the *Hypotheria* were, almost certainly, possessed of two occipital condyles, in common with *Amphibia* and *Mammalia*. And in any case, in order to establish the certainty of priority of birds over beasts, we must assume that the *Prototheria* were evolved from the *Hypotheria*, and then gave rise to the marsupials (or insectivora?) in the interval of time between the depositions of the lower and upper Trias (again assuming that the Connecticut

* Flammarion, "Astronomical Myths," p. 61. [The resemblance, however, is far stronger than can be recognised in the case of most constellations, if it be sought in the right way. There is certainly no long-tailed bear in the sky, but neither is there in nature.—R. P.]

† "Bureau of Ethnology," 1880–81, p. 80. Smithsonian Institute.

‡ Algonquin, "Legends of New England," p. 379. Leland.

§ Unless his remark that "the question of the exact meaning of 'higher' and 'ordinary' in the case of mammals opens up the prospect of a hopeful logomachy" be capable of interpretation as a challenge.

* I presume they would retain this title even should the marsupials be proved to be not intermediate between them and the *Eutheria*. Cf. George J. Romanes in the *Fortnightly Review* (p. 336, footnote), March 1886.

† I may here notice a curious misprint, which makes Mr. Clodd affirm that "whales" are abundant in the Trias.

prints are avian); or we must assume that, the abovementioned transformations having occurred partly in Palæozoic times, the passage from reptile to bird was effected during a yet earlier period of that epoch. The former is a gratuitous and needless, even if it be not a preposterous assumption; while, as regards the latter, attention must be drawn to the reptilian character of the Mesozoic birds; how in the Trias we find them addicted to quadrupedal habits; in the Jurassic, using the claws of their anterior extremities (probably) for "catching hold"; here but partially or not at all feathered, there well arrayed with teeth, and so on; everywhere, in brief, announcing themselves as undergoing a contemporary evolution.

In fine, if "certainly" be a fit expression to employ in dealing with a subject about which an authority like Prof. Seeley is so little sanguine, it would be preferable to summon it *after reversing* the order of succession announced by the authors of the "Story of Creation," as given in the first chapter of the Pentateuch, and the March issue of KNOWLEDGE.

PLEASANT HOURS WITH THE MICROSCOPE.

By HENRY J. SLACK, F.G.S., F.R.M.S.

THE biting and chewing organ of rotifers is commonly called a gizzard, but it does not correspond with the grinding machine of the fowl, or with the remarkable one of the house cricket or the coarser one of the blackbeetle. It is, as Gosse showed many years ago, a mouth, having certain resemblances to the trophi, or mouth organs, of insects, which are composed in the well-developed instances of beetles of two mandibles, or chief jaws, two maxillæ, or lesser jaws, and an upper and lower lip. If the student will examine these parts in a biting beetle, and then look at the mouth apparatus of a gnat, a flea, a bug, a butterfly, and a bluebottle, the first impression will be that each one belongs to an entirely different plan. The beetle is evidently a biter with cutting and tearing forceps. It can *bite* a hole in a hard substance, but has no boring or piercing tool and no saw. The flea has exquisite saws; the bug, three very fine lancets and a sucking tube. The gnat is not a biter; she—for the female is the tormenting one—possesses six sharp-pointed lancets, two of which (the maxillæ) have some sawlike teeth at the top. There is also a long, stout, cylindrical piece ending in a cleft knob, like the opening bud of a flower. All these parts can be traced as modifications of the corresponding parts of the mouth of a biting beetle. The stout long cylinder is an immense prolongation of the lower lip (labium), the lancets are modifications of the mandibles and maxillæ, and so on. The bluebottle's mouth is formed as a sucking machine of another type. It is remarkable for a number of partially open tubes—modified tracheæ—and this sort of construction is carried to a wonderful extent in the Daddy Longlegs gnat, which has over three hundred of them.

Speaking generally, when any organ shows a capability of considerable modification, some species of creature is sure to exist in which the modified organ is so widely different from the simplest form in which it is known that the resemblance (homology) can only be traced by studying the intermediate gradations.

The rotifer's mouth, which can only be thrust out in some species, is a biting and chewing machine, exhibited by the pitcher rotifers, or *Brachions*, in the greatest perfection. Let us examine one of them with Mr. Gosse's assistance. First there is a globular bag which contains and moves the various parts by means of appropriate muscles. There we find the parts shown in the annexed view (fig. 1), borrowed from Gosse. The muscular bag *a* he calls a *mastax*, which means mouth or jaws; *b* is a com-

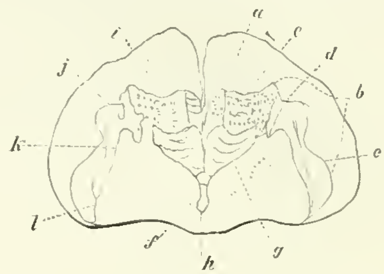


FIG. 1.

plex piece. the *malleus* or hammer; *c*, its handle (*manubrium*); at *d* is a joint articulating the handle to *e*, the *uncus* or hook; *f* is another complex piece, forming the *incus* or anvil, being the part on which the hammers strike; *g* (lettered only on one side) represents two pieces—*rami*, or branches—hinged on to *h*. the fulcrum, so as to open and shut. The motions of all these parts when in action are very complicated. What may be called the toothed or ribbed heads of the hammers come together and fall on the corresponding parts of the anvil, which has its own motions. This wonderful organ can exercise some choice, and if an impracticable or unfit substance gets in the handles give a sudden twist and toss it out.

In watching the proceedings of a pitcher rotifer we never witness the amount of chewing that might be expected from the complexity of the machine. Most of the objects swallowed pass into the stomach after a few grips which do not pulp them, and often do not alter their appearance.

As in the case of the insect mouth, the modifications of the rotifer mastax may be referred to more or less suppression of some parts and extension of others, and, whether Mr. Gosse's comparisons of the mouth organs of the two groups be completely accepted or not, very interesting and important lessons may be learnt by studying them together. Fig. 2, representing the mouth of *Notommata clavulata*, shows a considerable simplification of fig. 1, and fig. 3, *Furcularia marina*, a still more remarkable divergence

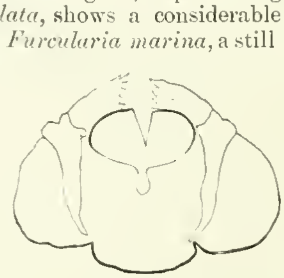


FIG. 2.

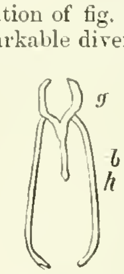


FIG. 3.

in the direction of simplicity. Those who wish to study the various forms in detail should consult Mr. Gosse's remarkable paper in the "Philosophical Transactions,"* illustrated by eighty-five drawings. Dr. Hudson is giving, and no doubt will continue to supply, sketches of the mouth organs of the various British species as his work progresses. This monogram would be improved by giving a little more information in the letterpress, and supplementing the uselessly large figures with more anatomical detail. A drawing 6 inches long, showing no more than would be displayed perfectly in one of 2 inches, is a mistake. It is

* February and March 1855.

also injudicious not to indicate the amount of magnification in each case.

Amongst the rotifers with comparatively simple mouth-organs those belonging to the *Asplanchna*, or bowelless species, are of great interest, as their perfect transparency makes it easy to work with both high and low powers. The biting machine of *Asplanchna* is like a pair of young deer's antlers, with sharp projections. It is a nipper, not a grinder, and often lets swarms of live objects through without noticeably injuring them. The voracity of the creatures is amazing, and the present writer supplied some curious illustrations of this in the "Intellectual Observer" (vol. v. p. 182). In the stomach of one *Asplanchna* were seven small rotifers, the jaws of an eighth, one arcella, a quantity of imperfect crystals, perhaps uric, together with a mass of matter sufficiently digested to conceal its origin. The stomach of these creatures is very elastic, and is not inconvenienced by large hard objects that force it quite out of shape. When it is tired of them they are pitched out by the way they came in, together with other indigestible débris.

An exceedingly voracious animal, which bolts its food at a rapid rate, evidently throws hard work upon its stomach. If we have to stew a mass of matter quickly into a soft pulp, we stir it well about in hot water. The *Asplanchna* is not provided with a spoon for this purpose, but its stomach is lined with active cilia, and they force currents of the digestive fluid in all directions amongst the objects to be acted upon. The direction of these currents fluctuates as the resistance gives way, and the sight is a fine one with powers of from 500 to 1,000 diameters. Fig. 4 is from a sketch made by Mrs. Slack under the

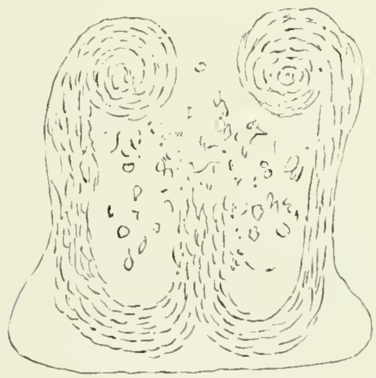


Fig. 4.

latter magnification. It would be an interesting task to examine a variety of rotifers and see in what cases stomach currents were employed as important aids to digestion.

The aspect of the mastax of many rotifers as seen in one position when the creatures are alive is apt to mislead the observer in imagining a form they do not possess. The organ should be viewed in all directions, both while it is in the animal and after the whole of the soft parts have been removed by solution of caustic potash. Mr. Gosse frequently found it necessary to cause the apparatus to turn over, which can be done by using the screw of a compressorium and making wavelets in a water-drop holding the object.

With every wish to recognise and welcome "The Rotifera," and to give due credit to Dr. Hudson, we cannot help wishing Mr. Gosse had been able to take a larger share in the new work, which would then have been free from the blemishes pointed out. The third part, lately out, describes and figures many of the most interesting genera, including *Asplanchna*. The three parts are intended for one volume, but we imagine most purchasers will consider it too thin and bind all together when complete.

THE NATURALIST'S LABORATORY.

Contribution I.

DURING the past few years the rapid progress of natural history, which has marked our era as pre-eminently the scientific age, may be claimed with justice to have resulted chiefly through the importance attached to practical laboratory work. All our most eminent teachers are agreed that a sound scientific training must be a permanent educative process; that a true knowledge of the forms and functions of living things, as well as of inert matter, can no longer be regarded as attainable through pure speculation, or anything which savours of things metaphysical, as it was in mediæval times, but must be sought for by each worker through diligent observation and experiment. A sound preliminary training, adapted to lead the student to future original research, is thus reduced to one of actual practice. His first step must necessarily be one of verification; he should not take for granted that what previous workers have stated is absolutely true, but endeavour to ascertain by experiment the actual worth of their records; for, in the majority of instances, personal errors play an important part, so that when researches are published it would be of great value to future investigators if the authors would always note the precise plans followed in attaining results from which they deduce their conclusions. To a neglect of this duty may be traced much of the aimless disputes which characterise the terminations of many so-called learned societies' proceedings; whereas, its observance would afford a ready means to other workers for the correction of individual errors and the advancement of truth. Such a plan, if universally followed, would also enrich the laboratory immeasurably, for every original paper would contain notes of some instrument, some receipt, or some novel method of value to be added to its stores.

The naturalist's laboratory of to-day is very prone to degenerate into a kind of lumber-room, because of the want of definite information in a compact form, to meet the requirements of the present day. The principal aim of the series of contributions of which this is the first, is to supply a systematic compilation of notes for the guidance of both private and public students, to enable them to derive the benefit of all the most valuable results of former workers, both ancient and modern, to the utmost, and thus to facilitate research.

Until recently the term naturalist was applied more exclusively to certain lovers of the beauties of nature, who prided themselves upon studying the general habits of plants and animals, making collections of their dead remains, and naming them after separate fanciful codes. The naturalist's laboratory of the time of White of Selborne, or even of the late Sir William Jardine, wore more the aspect of a kind of old curiosity shop than of a scientific worker's *sanctum*; where birds' skins, dried plants, cured insects, shells of molluscs, and fossils were carefully stowed away in drawers redolent with camphorated essences, &c. The mania for merely collecting and arranging was not then confined, as it is now, to what are aptly called "scientific amateurs," but was followed more or less by all the leading men of the day, from Linnæus downwards. It has at length been fortunately developed in the right direction, and public depositories in the form of museums of science and art have been widely instituted. Here the storage of birds' skins and dried plants assumes its normal place; they are of specific value to the general taxonomist, and, when carefully prepared, are second only to elaborate and accurate works of pictorial art.

The prevailing idea amongst the older biologists of the present age seems to have been that a collection of birds' skins, cured, stuffed out with cotton-wool, and laid ensheathed in wrappers like mummies, fulfilled all the requirements of the scientific taxonomist; they were, in the true sense of the term, taxidermists, and nothing more. Gradually the term taxidermy was applied, not so much to the classification of skins as to the art of curing and mounting them, and the taxidermist degenerated into the pet preserver of poodles, parrots, and canaries. This, however, exercised a beneficial influence upon the art of skin-preserving, and in most of our museums we find examples of stuffing of rare excellence. The life-like attitudes of animals first initiated by Waterton, who is supposed to have latterly carried out a craze for blowing his skins out with air, was quickly followed by others who made a business of it. The highest development of the art which it has been our good fortune to witness has without doubt been only recently achieved by Saville, many of whose *chef-d'œuvres* are now in the possession of a Mr. Chase in Birmingham. To describe any of his works will be to give an outline of the most successful results of this kind that have hitherto been achieved. One case, which may be taken as an example, consists of a group of graceful water wagtails in their natural habitat; the postures of the birds are life-like, each one having been carefully studied from nature through the untiring energy of the artist: every feather, ruffled or smooth, is naturally set; the imitation glass eyes, the very eyelids, beak, feet, and nails, are all covered with some material which imparts to them a freshness of form and colour which can scarcely be distinguished from the living tissues even upon close inspection; the general surroundings, moreover, are all modelled after nature; every stone, every blade of grass in the case has its prototype in the fields. When brought to this state of perfection, the preservation of skins is at once raised to the rank of a fine art, and ought to be valued accordingly; but to the searcher after the truths of nature it must be regarded as an item of minor worth.

Dried skins, dried plants, the shells of molluscs, and preserved insects, are, in the present state of our knowledge of animated beings, useful merely for the purposes of provisional, specific, and varietal classification, for absolute knowledge concerning the genesis and relations of the many forms of life can only be gained through exhaustive experiments in the domain of anatomy and physiology, both mega- and microscopical. When the skins &c., however, are employed by artists to depict phases in the life-habits of the organisms, their value to the naturalist becomes greatly enhanced, and it will therefore form part of our future duty to record a series of notes upon taxidermy as it is now practised.

Fossil remains afford a more extensive field for inquiry than the mere dried integuments of living things, for here nature very often operates as a dissector, and reveals structures by means of which many problems of great importance are capable of being solved. Fossilisation is now understood to take place under only peculiar circumstances; the soft-bodied creatures which inhabit the waters of the globe are but seldom preserved, since, upon sinking to the bottom, their bodies rot away till no trace of their former existence remains; thus it is that very few anemones of this nature are preserved. But where the anemone develops a hard skeleton that remains preserved either in the form of a pseudomorph (where the original particles have been replaced by others of secondary derivation) or in its primæval condition, a fossil coral is the result. The shells of molluscs are perhaps best suited for preservation, and are situated, whilst living, in the most favourable conditions for becoming fossilised: they are thus found in abundance as fossils, and have been taken as the basis of classification of typical formations in the geological record. Terrestrial plants and animals, the latter especially, are fossilised only under accidental circumstances, their bodies, submerged in former lakes, decay away, to leave little beyond the internal framework or skeleton; and it is thus that nature acts as a dissector, for the specimen preserved in this way affords evidence of the true place in nature of many living forms whose relationship is thus undeniably proved by the petrified remains of their extinct missing link. The collection and preservation of fossils is hence well worthy of the attention of the naturalist, and we shall devote some space to the consideration of this subject in the sequel.

To pass back to living things, of greater importance than the collection and preservation of skins, &c., comes the study of bones, or osteology. It is the basis upon which the young anatomist should found his future work, for he can never understand anything of importance connected with his subject—the movements of the muscles, the disposition of the blood-vessels and nerves, &c.—without first grasping the significance of form and relations of bones. There can be no doubt that the best way to become familiar with the osteology of any animal is the practical one. By preparing and articulating the skeleton of any one subject, a more permanent knowledge of its bones will be derived than by any amount of study with a skeleton prepared by others. Practical osteology and articulation, followed after the directions which we shall give for cleansing and mounting certain typical examples, will, we trust, stimulate students to future accurate anatomical research.

Although it is not our intention to make this a dissector's guide to the anatomy of any group of animals or plants, special attention will be paid to the general methods of research, which are seldom, if ever, adverted to in the many current text-books of anatomy and physiology. This will enable our readers to follow the best plans, and to use the instruments best suited to their requirements. For instance, in working out the anatomy of the common earth worm, if the subject is not properly prepared beforehand, carefully fixed in the right position in a bed of material of the right consistency, and operated upon with scalpels and needles of particular designs, the utmost skill will not avail, and the work of the dissector become a painful labour instead of an interesting study. These remarks apply equally to other departments of practical anatomy where special instruments and processes have been invented from time to time to render the work of the investigator pleasant, simple, and successful. The preparation of anatomical specimens for museums will here be taken as the foundation whereon to build up this portion of our laboratory.

The preservation and preparation of living things, as well as of inorganic materials, presupposes that they have been captured or gathered in some way or other, and in many instances the naturalist is forced to cater for himself. Field work is, indeed, one of the most important of the student's duties, and although it cannot be regarded as any part of his occupations within the walls of his sanctum, all nature must be looked upon as his workshop, and in that sense the tools which he requires for dredging, pond-hunting, insect-capturing, stone-breaking, &c., will afford scope in the sequel for a series of discourses upon excursions.

Half a century has passed since the most important addition to the naturalist's laboratory was made in the form of the compound microscope. With its assistance an ever-increasing field for research has been opened; but the biologist and geologist are here both hampered with numerous difficulties, for, before the instrument can be worked to its full advantage, the majority of objects require to be specially treated so as to reveal their characteristics.

Our observations in this department will, however, be confined to the equipment of the work-room rather than to a detailed account of microscopic objects, which are discussed in another portion of this journal.

But to return to the laboratory *per se*; there can be no doubt that, although a special apartment wherein to conduct research is not absolutely necessary, yet, where such is available, it tends very largely to secure that comfort and convenience which lead to an inducement to labour. On this account the selected chamber should be so constructed and arranged as to embody all the necessary hygienic modern improvements, in addition to the special requirements of the student. It will not, therefore, be out of place if we devote our next contribution to a consideration of the salient features of a thoroughly well regulated naturalist's laboratory.

AMERICANISMS.

(*Alphabetically arranged.*)

By Richard A. Proctor.

[A good-natured critic, of the cheap (and "nasty") sort, kindly characterises these notes on American expressions as "cribbed from Bartlett." As I indicated at the outset my obligation to Mr. Bartlett, I do not consider that I need now say anything further on that point, except to note that I have found his book much less trustworthy than I hoped, and that therefore my obligation is much less than I had expected it to be when I frankly referred to it by anticipation. Yet a critic who has never seen Mr. Bartlett's "Dictionary of Americanisms" is, doubtless, quite honest, however ill-informed (and unmannerly), in describing me as "cribbing" from it.]

Different from or *to*. They assert in America that we in England say "different to," whereas over the water they more correctly say "different from"; in other words, they claim to set us right in regard to the use of the word "different." It is hardly necessary to say here—i.e. in addressing English readers—that with us "different to" is regarded as an offence against grammar quite as much as in America. I had repeatedly noticed "different to" in American writings, and supposed it was a fault of speaking which they shared with our ungrammatical classes, until one day I heard it said that the fault was peculiar to English writers. I suppose some Americans, acquainted with the proper way of using the word "different," that is, in company with "from," and reading English books with the idea of noticing characteristics of English writing, have paid more attention to the mistake of using "to" after "different" in English books than in reading American books. But I can assure them that in American works the mistake is quite as common as in English. In like manner, I have been assured in Scotland that in England we much more commonly say "he laid" for "he lay," or "it lays" for "it lies," than they do in Scotland; whereas, on the contrary, English readers when they come across the mistake in Scottish writings, suppose it to be a peculiarly Scottish mistake. Bad grammar is spoken wherever the English language is spoken.

Difficulted. For "perplexed." This is peculiar to the South, and some assert to Georgia. In Scotland, however, it was formerly used, and the verb *to difficult* appears in Jamieson's "Scottish Dictionary."

Diggings. This expression for "a place of working," and later for "a place of abode," had its origin first in Western America at the lead mines. A man's *diggings* were the place where he was digging for ore. The expression would hardly have originated except in a community where everyone was employed in the same way, or extended readily except in a nation where to work is considered the duty of every man, and idleness degrading.

Dime. A silver coin worth ten cents.

Dime Novels. Trashy novels, because the novels sold for a dime are usually trashy. Yet no English novel-writer can be sure that his works, especially his shorter stories, may not be sold for a dime in America, badly printed or even villanously illustrated.

Ding. Equivalent in the South for "darned." Short for

Dinged = "darned."

Dingee, Dinky. Same as our English "dingy."

Dip, Dipping. Some American ladies, especially in certain Southern States, take snuff in a particularly attractive manner. A little stick of pine, about three inches long, split like a brush at one end, is wetted and dipped into snuff. With the snuff thus taken up the teeth are rubbed, "sometimes by the hour together," Mr. Bartlett states. Others tie the snuff in a little bag and chew it. But the other way, called "dipping," is the more elegant. The lips assume a singularly lovely appearance after a few years' dipping.

Dipper. (1) A pan with a handle for dipping water. The seven leading stars in Ursa Major, which with us are the Plough and the Churl's Wain (or, by a curious corruption, Charles's Wain), are in America called "The Dipper." (2) One who takes snuff after the objectionable manner described under *Dip* and *Dipping*.

Dirt. In America the word "dirt" is used where we say "earth." Thus a road in America repaired with earth of any sort is said to be repaired with dirt. Bartlett says a turnpike road is a dirt road; but this is not a correct way of putting it. In Virginia, for instance, the turnpike roads are "metalled," and distinguished, as such, from unmetalled or dirt roads. Our children retain this older use of the word when they speak of an earth pie as a dirt pie.

> Sitting as good as goold in the gutter,
> A-makin' his little dirt pies.—Hood.

Disgruntled. Disappointed; disconcerted. The following extract from the "Springfield Republican" illustrates not only the use of this elegant word, but the bland and childlike ways of Young America:—"The Reverend Newman Hall, of London, tells how, when he was journeying to Chicago, an apple-pudding boy on the cars, without any preliminaries, took hold of and immediately examined his breastpin. Nevertheless the reverend gentleman, quite *undisgruntled*, remarked, 'Was it not there to be seen? Was he not a man and a brother?'" The word may be met with in old English writings.

Disguised. Americans fondly imagine the expression "disguised in liquor" to be an Americanism. It is of course English slang, of great antiquity.

Disremember. Not to remember. Good old "bad English."

Distressed. Pronounced *distrést*. Wretched. "Poor *distrést* wretch," as we might say "*poor dévil*." Really, a nigger expression.

District schoolmaster. The master of a public (i.e. free) school in a district. The master of such a school seems to be mostly a poor distrést wretch, in the most emphatic sense of the words. Generally pronounced *deestrick*.

Dite. This word, the equivalent of our old English "doit," is an interesting New England survival. "Not a doit I," we find the Elizabethan saying; and now in New England, "I don't care a *dite*."

Divide. A watershed. I have never heard this expression used out of America, and only in Western America.

Divort. Bartlett finds this word distinct from *divide* in implying elevation as the cause of the division of waters.

Dixie. The name of a very kindly slave-owner on Manhattan Island, whose slaves, increasing faster than the land, had to emigrate. After his death his virtues as a master assumed a semi-mythological aspect, and Dixie's Land became an equivalent for a sort of nigger paradise.

Dodger. Hardbaked cake or biscuit. Thomson says this word is a corruption of *Deadgarred*, thoroughly done. Let us hope so.

Do don't. Nigger English for *don't*—showing the taste of lower races for reduplication.

Dod rot it. Americans claim this as a pleasing relief-expression. But it is tolerably good old English mock profanity, like "'Od rot it" (or "him" or "them" as the case may be).

> What are they fear'd on, fools, *'od rot em!*
> Were the last words of Higginbottom.

And Higginbottom was not a Yankee.

Dog-goned. This, however, may be American. In the "Farm Ballads"—

> But when that choir got up to sing,
> I couldn't catch a word;
> They sang the most *dog-gondest* thing
> A body ever heard.

Dogged. For con"demned" theologically. I'll be dogged if I do.

Doings (pronounced *doins*). Food provided for a guest or company. See *Chicken-fixings.*

Do, used instead of "do for," seems peculiarly American. "That will do me," *i.e.* suit me.

Donate. Americans try to persuade us that the word "donation" is American. But of course donation for a gift of considerable value is found in English writings of a time long preceding the Day of Independence. "Donate," however, as a verb formed from "donation," as "collide" from "collision," is unquestionably an American word, and a very unpleasing word it is.

Donation Party. A party collected to make presents to a clergyman, where the parishioners are not generous enough to give him a suitable salary.

Done, used instead of *did.* Bartlett makes the odd remark that this vulgarism is common in the State of New York, and also heard in the province of Leinster, Ireland. (This reminds one of the example in the "Art of Sinking," which tells us how a person whose name I "disremember" was not only

> The great god of war,

but also, and moreover, was

> Lieutenant-Colonel to the Earl of Mar.)

Done for *did* is a common vulgarism wherever the English language is spoken. It is only an Americanism in being heard oftener in America than in the old country, and especially in being heard among classes who might be expected to know better.

Done used in an adverbial way is a negro vulgarism. "*Done* gone" means "gone quite away," as Mrs. Nickleby's admirer put it. "He's done gone and done it" is a singularly emphatic bit of nigger phraseology. "*Done* dead" means rather more dead than mere death unqualified would imply: the expression is known to be of negro origin, or one might attribute it to "Leinster, Ireland," and also to Ulster, Munster, and Connaught, where one may not unfrequently hear the expression "murdhered inthoirely."

Don't amount to much. Mr. Bartlett is kind enough to explain that this corresponds with what we mean in England when we speak of any one as "no great shakes." But "don't amount to much" has been used in England a good deal longer than Mr. Bartlett imagines, and "no great shakes" is sheer slang—in England (and in America too, where this expression, probably derived from apple-growing regions, is often heard).

Doted. Changed, or half-rotten. Probably equivalent to our old English *doited.*

(*To be continued.*)

AMATEUR PHOTOGRAPHY.

By T. C. Hepworth.

THERE was recently shown in one of the Bond Street galleries a collection of more than two thousand photographs, the whole of which were the work of amateurs. The idea of holding such an exhibition originated with the London Stereoscopic Company, by whom valuable prizes were offered to competitors in several different classes of subjects. Thus one class was reserved for marine subjects, another for landscapes, another for the work of beginners, and so on. Without entering into any detailed examination of the various pictures exhibited, we may usefully call attention to several points in connection with them which seem to us worthy of remark.

Not alone did this exhibition show an advance in general acquaintance with photographic manipulations on the part of amateurs, but it illustrated in a remarkable manner several important steps in the recent history of photography itself. In the first place, every picture here without exception owed its creation to that system of dry-plate photography which came upon us like a revelation only six short years ago, a system which has rendered possible the "delineation" of so-called instantaneous effects. Nor was this collection of pictures devoid of several excellent examples of this most startling application of the camera. Here, for example, was a marvellous rendering of a flash of lightning which at once called to mind the branched, crackling discharge from a large induction coil. How different this from the stereotyped zigzag line which artists for centuries have been content to accept as a typical representation of the thunderbolts of heaven! Passing from things sublime to those of a very mundane character we saw in Dr. Alabone's instantaneous studies a boy playing leapfrog, and actually for the moment poised with his finger-tips on the bowed back of his companion in sport. In the same frame were a couple of swimmers in the act of entering the water from the top of that unpicturesque object, a bathing-machine. Both were in mid air, one taking a fair "header," and the other turning a summersault.

Another recent advance in photography was illustrated by the large number of pictures which were printed by the platinotype process, and which, apart from their engraving-like, artistic appearance, have the merit of undoubted permanence. The discoverer of this process is able to boast that no chemical agent short of warm *aqua regia* can destroy the platinum image. In other words, the picture is far less destructible than the paper which supports it. Then, again, in the many representations of mountain scenery we had an exemplification of the very latest advance in photographic art, whereby the tourist is relieved of the weight of glass, and can take his pictures, panorama fashion, on a roll of prepared paper, otherwise known as the "Eastman film." By this new system the weight of apparatus is reduced to such an extent that an Alpine climber is able to carry his camera to altitudes

which, under the old condition of things, would remain inaccessible to the photographer unless he were accompanied by a retinue of porters.

It is evident that the time has gone by when critics could turn from the work of amateur photographers with a sneering word, and we may feel sure that John Leech's inimitable satires in this direction would, if published now, entirely lose their point. With opportunities of "taking" all kinds of different subjects, with means and leisure to search the world over for unfamiliar scenes and curious character-studies, the amateur worker has many advantages over his professional brother, who is bound to consider the bread and butter side of the art before everything else. If there be any who hold that this fashionable hobby of photography is a disadvantage to those who are professional workers, let them remember for a moment that it is those very amateurs whom they blame to whom the credit is due of bringing the art to its present perfection. Ten or twelve years ago, while the professionals were busy making their living, and in numerous cases a very good living, too, by taking portraits by the old collodion process, there was a handful of amateur workers who were spending their time and money in experimenting. They were anxious to simplify photographic manipulations by preparing the chemical film as a dry surface, so that wet plates, collodion, and all their attendant messes might be superseded. Gradually it leaked out that these workers were elaborating new methods of procedure. At first they might be counted on the fingers; then they increased by tens and twenties. In the meantime the professionals laughed at these efforts, and said that the new methods were toys—all very well for amateurs, but which could never oust the old well-tried wet-plate process. Suddenly working details of gelatine plate-making were published, and pictures were produced which showed their marvellous capabilities. The professionals at last woke up from their sleep of fancied security, and now every worker in the kingdom puts his trust in the once despised gelatine plates, which owe their origin to the equally despised amateurs.

To return to the Bond Street Exhibition, we note that the majority of the pictures shown naturally consisted of landscape studies, for such subjects abound on every hand. Next, there were bright little peeps into that happy home-life which is no less characteristic of old England than are its shady lanes, its breezy downs, and its chalky cliffs. But beyond these there were pictures which were of peculiar interest as being valuable from a scientific point of view. We have already noticed the truthful representation of a lightning flash. Many other natural phenomena can be far more readily pictured by King Sol, as was proved by many of the subjects in this collection. A geologist could trace out in more than one of them the old, old story told by the rocks. Here a beautiful example of stratification; there a mass of basalt, crystallised ages ago, from a heaving molten mass into beautiful hexagonal pillars; here, again, some isolated rock masses which, in a far-off period, have been pushed from their bed by the action of ice. But here, too, are glaciers in actual operation. In some most perfect photographs by Mr. Muller (scenes in the Engadine) we can trace the very life history of a glacier, from its first advent as fleecy snow, then its gradual descent—a sea of ice—down a winding valley; and lastly, we can discern in its melting foot the source of some mighty river. In another picture is seen the gradual advance of a storm cloud over a mountain top, which presently will expend its fury upon everything around, including the luckless photographer who dared its wrath. Close by, as a contrast, is a scene full of sunlit tranquillity—an orange-grove in Florida, with the luscious fruit as thick upon the trees as apples in an English orchard. Here, too, is a collection of flints from Kent's cavern (Torquay) which would delight the heart of Mr. Pengelley. Lastly, let us notice some exquisite examples of photo-micrography, an application of the art which has recently been much developed, and which threatens to supersede altogether the tedious, elaborate, but less accurate work hitherto done by the camera lucida.

We have said enough to indicate that amateur photography is no passing fashion which will presently, like a new bonnet, give place to some fresh caprice. It is an occupation which many take up with far more serious meaning than they would a mere pastime. In good hands it represents a valuable educational aid, from the necessary elementary knowledge of chemistry which it forces so pleasantly upon the attention of its votaries, to the study of Nature in her varied aspects, a study which, to those who strive to learn, is one of the highest privileges which this beautiful world confers upon mankind.

It would not be fair to close our remarks without acknowledging the generosity of the London Stereoscopic and Photographic Company in inaugurating this their second exhibition of the works of amateurs. We have all the more pleasure in doing so because the profits of the undertaking are devoted to a most deserving charity.

SOMETHING ABOUT THE ELEPHANT.

A CERTAIN dear old book says about the lordship of man over creation, "And the fear of you and the dread of you shall be upon every beast of the earth" . . . "and a little child shall lead them."

Nowhere is the truth of these sentences more distinctly seen than in the contact of man with the elephant, nor more marvellously than in the tacit subjection of its enormous mass and power to the tap of a child. Many a time have I seen, and with amazement, the huge animal following the lead of a mere mite whose only guiding was pressure with its palm on the great swaying trunk, the faintest hostile move of which would have yielded momentum sufficient to have destroyed the child.

Mark this mahout mounting his elephant by its trunk; seizing the tips of its ears, he places his feet on the trunk, and the dear animal at once lifts it and him upwards, and thus the mahout gains his seat upon its neck. It is remarkable to see this, inasmuch as the life of the driver is wholly at the mercy of the elephant, who can easily with the faintest move of his trunk pay off any old grudge against him.

It is remarkable to see this great animal in motion. As with the whale, so with the elephant—bulk does not add clumsiness to movement, but the reverse; you will see the elephant progressing silently, and apparently picking his steps, for each great foot is put down leisurely, not at haphazard. Unlike other animals, he can never get out of a walk, but he can walk very fast when excited, perhaps six miles an hour.

Some years ago an enraged elephant was able to overtake and kill his grasscutter, and this on a fair and open plain where speed was in favour of the man, but of course he had not the endurance of the elephant.

Apropos of the silent progress of the elephant, it is marvellous how he can, in his wild state, move through his native forest without being heard; nay, you may actually be beside him, yet be not aware of his presence.

The elephant seems a link with a lost fauna, for all round

he stands alone; the only approach to his trunk being that of the tapir. His drinking is unique; all animals drink by so-called suction, but he drinks by suction and pour—that is, he fills his trunk by suction, and then pours it into his water-stomach, where it is either assimilated or utilised again by the trunk and blown in grateful spray all over the heated body. The action of drinking is highly characteristic; of course in his native haunts he drinks from a river, or water-course, or tank, and wallows in either at pleasure. In captivity he rarely has this pleasure, but is watered from a bucket, leathern or wooden, and then he is quite satisfied as long as the tip of his trunk is fairly immersed.

I am not certain whether the elephant drinks by suction or vacuum (of course the former implies the latter, but it will be seen that there is a difference), and I have never seen the question discussed in the books. The following is the process: Water presented to him he at once blows down the trunk and then instantly immerses it; after a while he curls up the tip, and lifting the trunk and prolonging the curl he brings the tip into his mouth, throws back his head, and blows out the water, which you distinctly hear splashing in a cavity.

This process (and it is a slow one) goes on until he is satisfied, and then he clears out his trunk with a blast; as he breathes through his trunk, it is only in these intervals that he can inspire. If he drinks by vacuum, the following is the process, presumed at least: Simultaneous with the blast the posterior nares are closed, and the trunk is in vacuo; water rushes in by atmospheric pressure, and the trunk is filled and empted as above. This trunk is a wonderful organ, and the only instrument of prehension possessed by the animal, and it will as deftly pick up a needle with its finger as a bundle of sugar-cane with the whole organ. It is also, though very rarely, his weapon of offence, and a very formidable one, and yet a mosquito will keep it in check; and it is through his trunk that you win the animal's affection. Go up boldly, and in front, to a strange elephant and fondle his trunk, and you are safe; approach him from behind, and he will edge away from you suspiciously sideways, perhaps with trumpeting.

Like the whale, the range of an elephant's vision is very limited, and he has to move the whole body to take certain observations; therefore he is virtually purblind, and this makes him suspicious. He can't see anything on the ground below him, and his finger here takes the place of a third eye. It is great fun to approach him with a stick of sugar-cane behind you; its fragrance soon reaches his sensitive nostrils, and you will find the dear creature exploring your rear with his trunk-finger, grasping the cane gently, and removing it to his mouth.

From earliest antiquity the elephant has been utilised by man; we read of his achievements in war, when he used to carry a turret on his back charged with from six to eight warriors; now his maximum load consists of the howdah, with perhaps two sportsmen in front, and an attendant behind; this is for sporting purposes.

His main use now is to swell the effect of state pageants, and it is certainly a grand sight to see a long array of these noble animals, in all the bravery of their gold and silver howdahs, bells, and embroidered trappings. Many of these animals are of great age, and have historic associations connected with them; thus, it was only in 1873 that Warren Hastings' state elephant died on its way from Agra to Lucknow, on the occasion of Lord Northbrook's great Durbar. What an autobiography that animal might have written.

I do not know which is the most impressive sight—to see the wild elephant crashing through the forest, frightened out of its wits by the discharge of your piece, and trumpeting wildly in fear, or to see it in the majesty of intelligent subjugation, moving grandly in its place in the 40-pounder battery, and utterly regardless of the roar of the great guns.

And this reminds me that in her 40-pounder elephant batteries India possesses weapons of offence unapproachable by any other nation. One of these went into the Khyber Pass in the last Afghan war, and opened fire upon Ali Musjid at 3,500 yards; only the crest of the fort was visible above the plateau, yet it was reduced to ruins (though answering gun for gun), or, as the telegram stated, "Ali Musjid in rags."

Let us watch one of the majestic batteries on a field day—here they come, four 40-pounders and two great howitzers, each harnessed to two elephants, one in shafts and the other in front, with chain traces attached to the ends of the shafts. The mahout (driver) sits on the neck of each; note the docile animals as they grandly march up in two lines of six each, as they pass the flag they elevate their trunks S-like in salaam, and move on with stately tread. After the march past, and for manœuvring, twenty great white bullocks in war, and sixteen in time of peace, relieve the elephants, which cannot get out of the walk, and trot the guns all over the field.

The food of each of the elephants consists of, daily, 15lb of flour made up into nine cakes, or chăpátís, and 6 maunds of kerbi (Sorghum) for each large, and 4 maunds for each small elephant (1 maund=40 seers=80lbs. av.). To wash down all this, each elephant drinks, four times daily, according to size, two or three skins of water (măshăk), each skin holding one and a half maunds of water, and he has two baths daily in the hot weather, and these he enjoys thoroughly.

When all is quiet, about 10 P.M., elephants retire to rest, throwing themselves down on their right sides, and sprawling comfortably; for some time you will see their left ears flapping nervously, and the old trunk twitching, and then all is at rest—

> And these here mighty Pachydarms,
> Are fast asleep in Murphy's arms.

Though their skins are immensely thick, they are wonderfully sensitive, even to mosquito bites; I have seen an elephant feeding off bibal branches (*Ficus religiosus*), suddenly stop, take a branch in his trunk, scratch his back therewith, and then throw it away. Another, troubled with a loose tooth, was seen by a commissariat officer to insert his trunk into his mouth, and pull it out forthwith.

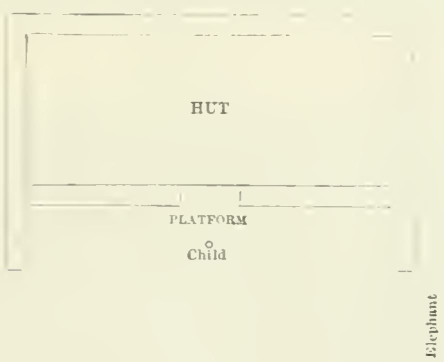
As I have already hinted, elephants are gentle, docile animals, and the exception denotes an exceptional mahout: he wields a formidable weapon, a relic of ancient barbarity, called the ănkoos, which I here represent, and according to his use thereof so is the temperament (misăj) of his animal; the inner edge of the hook is sharp, and is used with fearful cruelty on the lobe of the ear, while its sharp point is driven ferociously into the tissues of the vertex, exposing the yellow fat beneath the skin. The poor animal shrieks under the agony of these cruel prods, and I will presently show how he righteously treasures up wrath against his cruel mahout.

Not only is the elephant used in war (including transport) and state ceremonies, but he is also largely used in sport, especially tiger shooting, and here his strength, intelligence, and endurance are invaluable; he is also invaluable for draught, and in this respect I do not hesitate to affirm that the Burmah teak trade would collapse without his marvellous strength, intelligence and docility.

Once I had an elephant as my patient, and a touching case it was; the poor brute had a huge ulcer beneath its left elbow, as big as a slopbowl, and this the mahout used to fill up every day with pounded leaves of the *Croton tiglium*, and it was piteous to behold the agony of the animal during the application of this irritant. I consented to take the poor creature in hand, provided it was sent over to my house; this was done, and the relief of cotton wool soaked in weak carbolic was very striking. The next thing I heard was that the mahout had removed the elephant, because he could not be bothered to walk to and fro a mile for his own dinner, and the next, that the poor brute had dropped dead suddenly, after its walk back. A post-mortem, carried out with saws, axes, and hatchets, revealed an enormous fibrine clot in the left heart as the cause of death. I was also able to certify myself that in the elephant the testes were in the abdominal cavity.

Like other animals, elephants are apt to become insane, and then they either become maudlin or dangerous; a *mad* must not be confounded with a *must* elephant, an animal whose sexual στοργή has, ignorantly, not been satiated; but on the contrary, his fury has been excited by cruel treatment and the internal exhibition of highly poisonous and irritant drugs. A must elephant at large is a highly dangerous animal, and frequently death and destruction are in its track.

And now I will wind up these notes with an account of how an elephant paid off his mahout at Allahabad during the mutiny. The man was a merciless brute, and the animal long stood his cruelty, though, times without number, he had had the mahout in his power; the final retribution will be understood by this sketch. The day's



work over, the mahout dismounted at the platform of his hut, on which his child was awaiting him, went in, brought out a broom to sweep all around, leaving the elephant standing at one wall; several times he passed unhurt, until the elephant seemed to awake to the opportunities it had lost, and the next time the mahout passed between him and the wall, it moved forward a few inches, and five minutes after, when I saw the dead mahout, his face was at the back of his head. The dead man's child of four (he had no wife) led the elephant to its tree by the trunk which had slain her father. And thereafter the executioner would have no other guide.

R. F. Hutchinson.

Theologians of a certain class explain the discrepancies between ancient ideas about scientific matters and the actual facts in so many different ways that they ought to cease from accusing Science of contradicting the Bible until they have ceased to contradict each other. When they all agree in telling Science just what it is she contradicts, it will be time enough for Science to look into the matter a little.

Gossip.

By Richard A. Proctor.

Munich has been so often and so fully described that I do not find much to say about my visit there. Some features of the place seem worth noticing, however, even though I may be going over much-trodden ground.

* * *

I wonder whether a theatre could by any possibility be managed as successfully in London as all the theatres are managed here. To take the opera, which seems most completely to foil the efforts of managers in England, America, nay, in most parts of Europe and even of Germany. For the best seats in London the foolish public consent to pay a guinea, in order that singers like Patti, Nilsson, and Albani may be paid two hundred pounds a night and make a fortune for early squandering, after the manner of great *artistes*. In Munich the best seats at the Hof Theatre cost five shillings, though the singers are excellent—truer, as artists, than many of the stars so admired for mere roulading and high-note striking. But this is not all. In the chief opera-houses in London you can never expect to be free from the annoyance of some loud-speaking, unmusical neighbours, who mar the sweetest passages with their idle chatter. Once, perhaps, in ten visits you escape this annoyance, but the chances are much against this. In Munich no one wants to talk, they all come to listen and enjoy and let their neighbours enjoy. If any one should talk, his neighbours quickly assert their rights.

* * *

In England you never escape the annoyance caused by those restless folk who *must* get out between every act, trampling over ladies' dresses, upsetting opera-glasses, gloves, programmes, &c., on their way. The number of persons unable apparently, through some congenital brain weakness, to sit quietly for two or three hours, is so great that not once in a thousand visits to opera or theatre are their idiotic movements escaped. In Munich such movements are the exception, not the rule.

* * *

Then, again, those foolish folk who come late are allowed in England and America to spoil the pleasure of the more sensible. In Munich and elsewhere on the Continent the doors are closed at the beginning of each part of a performance, and those who arrive late have to wait until the part in progress when they arrive is completed. This is an admirable arrangement, and falls as a just punishment on the foolish and selfish. Yet another advantage is found in the sensible hours at which the theatres open. Of course the fashionable world in London and New York must dine late, and if they go to the theatre at all (which they might as well omit) the theatres must open later, so that the persons who form the bulk of the audiences must either lose part of the performance, or be content to get home after midnight. But I fancy the theatres would not have smaller audiences, and they would certainly have better ones, if they adopted the Munich plan of beginning at seven (or even half-past six for long operas) and seldom remaining open after ten.

* * *

Apparently the absence of an orchestra when plays are acted enables the managers to secure good all-round companies, and also prevents those long "waits" which discredit so many of our performances in England. I scarcely know which of the three advantages to consider most important; but perhaps most of us will agree that the avoidance of the atrocious music which in nine cases out of ten fills up the intervals in our theatres is even a greater gain than either

of the other two, great as they doubtless are. Think, however, of the satisfaction of first escaping the wearisome monotony of hearing badly-played dance music; secondly, having two or three hours wholly occupied by acting thoroughly good throughout—no weaklings marring the efforts of the better players, and lastly, not having to wait more than a few seconds between each act. Thus, to take yesterday evening (I write on May 6), we had "Der Geizige" (Molière's "L'Avare") and "Der eingebildete Kranke" (Molière's "Le Malade imaginaire"), admirably rendered, and followed by an interesting scene in which all the actors, in plain evening dress, joined in presenting a tribute of esteem to Herz on his completing the fiftieth year of his stage life, all being concluded before ten—three hours of perfect enjoyment from beginning to end. Naturally the Munich theatres are always full, except when, Patti or Nilsson coming here, the price is raised from five to twenty marks for opera or concert, and no tickets being taken except by a few Americans, those admirable singers decline to fulfil their engagements.

* * *

I RECEIVE a great number of letters still in regard to the doubtful (in reality not at all doubtful) passages in Josephus. I fear that argument and evidence are quite idle in such a matter. For those who, either through self-interest or dulness of apprehension, can maintain a position utterly unreasonable, cannot well be convinced by reasoning. Their stronghold, the *Credo quia incredibile* of St. Augustine, is quite impregnable. Were it otherwise, however, it would be very little worth attacking.

* * *

A CENTURY ago Voltaire wrote on this point, "All men of true learning are now agreed that the short passage relative to Christ in the history by Flavius Josephus has been interpolated." "The Christians," he proceeds in a note, "by one of those frauds called pious, grossly falsified a passage in Josephus. They invented for this Jew, so extremely zealous for his own religion, four awkwardly interpolated lines, and at the end of the passage they add, 'And he was the Christ.' What! Josephus had heard of so many events out of the course of nature, yet in the history of his country gives us but four lines about them! What! this obstinate Jew said that Jesus was the Christ! Then, if he believed him to have been Christ, he must have been a Christian. What an absurdity, to make Josephus talk like a Christian!" And then he calls to mind the much grosser impostures which, in the age of pious forgery, were piously invented to delude for their good the heathen who might otherwise have gone fatally astray.

* * *

As to the passage about John the Baptist, theologians having not quite such overwhelming evidence (or evidence quite so obviously overwhelming) against this passage, accept it as a valuable confirmation of their views. (Their evidence is in any case only *ex parte*, and of very little weight except when they honestly admit, like Warburton, Butler, Stanley, and others, the weakness of much which the dishonest still continue to put forward as valid.)

* * *

IT may be added to the objections cited (as a correspondent to whom I am already largely indebted points out) that: First, if Josephus had known about John what he is made to assert in this passage, he could not have omitted him in describing professedly *all* the sects and Jewish leaders. (But it was probably impossible to piously interpolate the necessary forgeries to obviate this objection.) Secondly, Justin Martyr, Tertullian, and Chrysostom could not but have seized on a passage so important; but alas! the pious interpolater came too late, and their eyes never rested on it. Thirdly, it praises John, though Josephus was a Pharisee, and John denounced the Pharisees. Fourthly, the interpolater being more pious than learned, so puts the story as to leave John's head to be brought a distance of a hundred miles from the citadel of Macherus to Herod; even on the most fiery "charger" this could hardly have been managed with the celerity indicated in Mark's narrative. Moreover, the charger on which the head was brought was of another kind. Fifthly—a mere trifle—the citadel of Macherus was at that time in the possession of Herod's bitter enemy Aretas.

* * *

WITH regard to Zechariah the son of Barachiah, it is perfectly obvious to any one not theologically inclined, that whoever wrote the gospel of Matthew means to indicate the entire range of the innocent who had been slaughtered, from the time of Abel down to the time of the speaker who said that all such innocent blood should be on the heads of the Scribes and Pharisees. It is simply absurd to imagine that that writer imagined the slaughter of the innocent had ceased with the death of Zechariah the prophet, who probably died comfortably in bed in the time of Darius, ages before his time. Unfortunately, not being strong as a chronologist, the writer put into the mouth of a contemporary of Pontius Pilate a remark relating to an event which occurred after Jerusalem was taken by Titus, some forty years after Pontius Pilate, according to the same account (and also according to Josephus), had put his contemporary to death. It may be more respectable—more religious even—to quibble over this matter than to say that the writer of the narrative had made a mistake, but it does not seem so to me. Different persons see the same thing in such different lights.

* * *

IT occurs to me as a noteworthy proof, for those who want such proofs, of the advanced scientific knowledge of the ancient Babylonians (or whomsoever they may have been from whom the old Jews derived their earliest records) that Abraham was promised a progeny equal in number to the stars in the sky. For it would have been a very poor outlook for the progenitor of a future nation (one progenitor—*plus* one *progenitrix*—was always held sufficient for a nation in those days) that his descendants should number a few thousands. But the actual number of stars in the galaxy would suffice for a quite respectable nation. In fact the trouble rather is, on this view, that the number of stars is too great for the prophecy, unless the Jews are hereafter to number some thousands of millions. Possibly we may reconcile matters (the difficulty has occurred to me only since I began this paragraph) by assuming inspiration equivalent in space-penetrating power to a telescope $10\frac{1}{2}$ inches in diameter.

* * *

A CORRESPONDENT puts this question:—"Is it correct to say that, supposing a man to be able to reach, in one second, the remotest star visible, and were to continue on to all eternity, doubling his speed every second, that he would never get to the end of worlds, but would always have as many in front of him as he had behind him? It seems absurd, yet appears to be a necessary consequence of the theory that 'end there is none—lo—nor is there yet beginning.' If, on the other hand, the last star could be reached in every direction, then the universe not only has bounds, but is as a mere grain of sand in the desert of space. This seems as absurd as the other. Of course I here use the word 'universe' in its largest sense."

I fear that to this question there is but one answer, "We don't know." The infinite, which necessarily is, is necessarily incomprehensible.

* * *

Among the signs of waning wit, in these hard days, must be recognised the increased favour in which mere word playing is held. The comic papers, or those which now-a-days do duty for such, seem to rely more and more on this most insipid form of fun. Some, indeed, have been started with no other apparent object but to show what absurdities can be reached in that direction. But then *such* papers are only vulgar because written for a vulgar-minded class. It should be otherwise with papers like *Punch*, originally started, and long maintained, as exponents of genuine wit and humour. True, among the first writers for *Punch* must be counted some who were much too fond of that agreeable servant but most hateful master, the pun. But such a writer as Thomas Hood punned merely in the excess and exuberance of his fun; he had true humour and true pathos at his command. (It should never be forgotten that his "Song of a Shirt" came out in *Punch.*)

* * *

Why should an innocent public be disgusted by those atrocious illustrated puns which have so long appeared weekly in *Punch*? The pun is good fun enough when it comes in casually in conversation, though even there it wearies if the casualties are too frequent; and when suspicion arises that any one is really lying in wait for opportunities to pun, the whole thing becomes a nuisance, and conversation a weariness of the flesh. Even this, however, terrible as it is, seems nothing compared with the iniquity of a man who deliberately sits down, with a dictionary, to invent infamously bad puns, and then gets a fellow-conspirator to draw (or himself draws) a bad picture to correspond.

* * *

One does not like to seem severe, especially on those who try to cater for our amusement; but really the editor and proprietor of a paper in which such cruel fun as this is allowed to appear should be subjected, for each offence (after the iniquity of their course has been shown them), to some really painful punishment—the perusal, for example, of a whole page of the *Topical Times* or the *Sporting Times*, or any of the organs specially intended for the vulgar. Obstinate persistence in wrong-doing might be properly punished by the infliction of a whole number, and, if the offender survived, by the order to commit to memory, and repeat daily, a dozen of the worst jokes (if any one could select them), or to analyse them, and inquire how they were probably invented.

* * *

Imagine, for example, the state of a man's mind, outside Bedlam originally, who had had to analyse many such jokes as this from the *Topical Times*: "'Have you ever seen a hen stealing?' says the wife. 'No, but I've seen a cock robbing,' replied the husband. 'Yes,' she commented, 'in the . . .'" but the rest is too feeble to bear removing. The analysis would result in showing how the inventor of this elaborate witticism said to himself: "Go to—I will make me a joke! What word shall I try to play on? I will think over the poetry of my childhood, and choose me a word from it. 'Who killed cock robin?' Let me see—'robin' sounds near enough to 'robbing' to do. A cock robbing—um, um, um!—a cock stealing—a hen stealing. Why, there it is! Bring a hen stealing and a cock robbing into the compass of three or four lines, and the public (that is, the public *we* write for) will find that a full-sized joke." *Hinc illæ lacrymæ.*

At that rate a man of average industry (and with a dictionary, *bien entendu*) will make you his hundred or so of such jokes *per diem*. But *Punch* ought to have nothing to say to such rubbish. The memory of writers like Hood, Jerrold, Thackeray, and Dickens should save the pages of our still leading comic paper from this dreary nonsense. Better than this would be even the ghastliest form of American fun—as suggestive of true humour as a grinning skull of cheerfulness.

* * *

A correspondent expresses annoyance because I have not hitherto answered in "Gossip" his question, Whether the 21st or 22nd of June is actually the longest day—especially as he had already asked that question in the anteroom of a place where I had lectured. I remember the occasion, and that I reached my hotel half an hour later than I had hoped in consequence; but I fail to see why this should lead me to resume the ungrateful task of answering correspondents in Knowledge. I may repeat, however, what I then laboriously explained, that the longest day is not the same in every year. That day on which the sun enters the sign Cancer is the longest day. I prepared my "Seasons Pictured," Knowledge Library, precisely to answer such questions; and when I consider how much labour I devoted to that work, and that it cost me something to get it printed and published, I venture to think that any one really interested in such matters might be willing to obtain the book, or to seek the information from others. It is a simple matter of fact that, if I answered all such queries as are thus addressed me, I could do nothing else. One might as reasonably ask a tailor for specimen suits as a student of science for letters of explanation.

* * *

I know not how it may be with others, but I find myself strangely moved by photographic records of the heavenly bodies. To see on a small area of photographic film the ripple marks of light waves which have travelled across the illimitable depths of interstellar space, taking years or centuries on their way, to close their career by writing down their record for the astronomers on our tiny earth—this, surely, is among the most amazing, one may almost say the most moving, achievements of the science of our day.

* * *

But some of the recent triumphs of photography in this direction are, to my mind, even more striking, when rightly apprehended. The photographic charts, for example, in this number and our last, at first view seem in no way more striking than one of the charts of stars formed by Argelander and his assistants. One would say they were ordinary engravings showing a great number of stars, some of them large, others of medium size, others exceedingly minute. One might even say, how neatly has the engraver rounded these tiny discs! and how carefully he has shown the smallest stars by the minutest conceivable dots!—less than mere pin holes!

* * *

But in reality every one of the white dots on the black ground has been engraved by the light waves of the corresponding star—aided afterwards by the stronger light of our own star, the sun. For, after the stars in a certain rich region had recorded their positions on a photographic film, and by solar action a positive had been formed from the resulting negative, a zincographic plate had to be formed from this star-drawn and sun-reversed chart. To do this the sun's rays were again called in to help the work of his brother suns, the stars, in that photographic field. On a film of gelatine his record of their positions was left, and afterwards certain acids poured on the gelatine film passed

through where the star images were, to a zinc plate, whose surface they cut into after their characteristic manner.

* * *

Thus was an engraving formed by the action of the stars and our sun alone—or, remembering that our sun is himself a star, we may say that the zincographic plate from which the chart was printed, was the work of the stars only! No human hand has touched the disc-shaped hollows by which each individual star has recorded its place.

PHOTOGRAPHIC STUDY OF STELLAR SPECTRA.

HENRY DRAPER MEMORIAL.

THE study of stellar spectra by means of photography was one of the most important investigations undertaken by the late Prof. Henry Draper. He was actively engaged in this research during the last years of his life. His plans included an extensive investigation, one object of which was to catalogue and classify the stars by their spectra. Mrs. Henry Draper has made provision, at the observatory of Harvard College, for continuing these researches as a memorial to her husband. The results already obtained, with the aid of an appropriation from the Bache Fund, permit the form of the new investigation to be definitely stated. The part of the sky to be surveyed is that extending from the North Pole to the parallel of 30 degrees south declination. Each photograph will be exposed for about one hour, and will include a region 10 degrees square. The telescope employed has an aperture of 20 centimètres (8 inches), and a focal length of 117 centimètres (44 inches). The object-glass is covered by a prism, and the resulting spectrum of each star in the region photographed has a length of about 1 centimètre, which enables the character of the spectra of stars from the fifth to the eighth magnitude to be determined. A modification of the apparatus is employed for the brighter stars.

Meanwhile experiments are in progress with the 15-inch equatorial, with the object of representing the spectra of some typical stars upon a large scale. The spectra so far obtained are about 6 centimètres in length, and exhibit much well-defined detail. Additional experiments will be tried with a spectroscope provided with a slit, as well as with the simple prism hitherto employed, in order to secure the best possible definition. The present results encourage the expectation that the movements of stars in the line of sight may be better determined by the photographic method than by direct observations.

To keep the astronomical public informed of the progress made in this work, specimens of the photographs obtained will be gratuitously distributed from time to time. The first of these distributions will probably be made in a few weeks. Owing to the expense of providing a large number of copies, it is desirable to limit the distribution, so far as possible, to those who are interested in this class of work. It is also desired, however, to send the specimens to all who will find them of value from the scientific point of view. A blank form of request is attached to the present circular, and may be filled out and sent to the Harvard College Observatory by any one desirous of receiving the specimens, but requests to the same effect in any form which may be convenient will also be cheerfully complied with so far as may prove practicable.

EDWARD C. PICKERING,
Director of Harvard College Observatory.

Cambridge, U.S., March 20, 1886.

Theology as Science.—I conceive that the origin, the growth, the decline, and the fall of those speculations respecting the existence, the powers, and the dispositions of beings analogous to men, but more or less devoid of corporeal qualities, which may be broadly included under the head of theology, are phenomena the study of which legitimately falls within the province of the anthropologist. With theology as a code of dogmas which are to be believed, or at any rate repeated, under penalty of present or future punishment, or as a storehouse of anæsthetics for those who find the pains of life too hard to bear, I have nothing to do; and, so far as it may be possible, I shall avoid the expression of any opinion as to the objective truth or falsehood of the systems of theological speculation of which I may find occasion to speak. From my present point of view, theology is regarded as a natural product of the operations of the human mind, under the conditions of its existence, just as any other branch of science, or the arts of architecture, or music, or painting are such products. Like them, theology has a history. Like them also, it is to be met with in certain simple and rudimentary forms; and these can be connected by a multitude of gradations, which exist or have existed among people of various ages and races, with the most highly developed theologies of past and present times. It is not my object to interfere, even in the slightest degree, with beliefs which anybody holds sacred; or to alter the conviction of any one who is of opinion that, in dealing with theology, we ought to be guided by considerations different from those which would be thought appropriate if the problem lay in the province of chemistry or of mineralogy. And if people of these ways of thinking choose to read beyond the present paragraph, the responsibility for meeting with anything they may dislike rests with them and not with me.—*Professor Huxley in the "Nineteenth Century."*

Jewish Theology.—We are all likely to be more familiar with the theological history of the Israelites than with that of any other nation. We may therefore fitly make it the first object of our studies; and it will be convenient to commence with that period which lies between the invasion of Canaan and the early days of the monarchy, and answers to the eleventh and twelfth centuries B.C. or thereabouts. The evidence on which any conclusion as to the nature of Israelitic theology in those days must be based is wholly contained in the Hebrew Scriptures—an agglomeration of documents which certainly belong to very different ages, but of the exact dates and authorship of any one of which (except perhaps one or two of the prophetical writings) there is no evidence, either internal or external, so far as I can discover, of such a nature as to justify more than a confession of ignorance or, at most, an approximate conclusion. In this venerable record of ancient life, miscalled a book, when it is really a library comparable to a selection of works from English literature between the times of Beda and those of Milton, we have the stratified deposits (often confused and even with their natural order inverted) left by the stream of the intellectual and moral life of Israel during many centuries. Imbedded in these strata, there are numerous remains of forms of thought which once lived, and which, though often unfortunately mere fragments, are of priceless value to the anthropologist. Our task is to rescue these from their relatively unimportant surroundings, and by careful comparison with existing forms of theology to make the dead world which they record live again. In other words, our problem is palæontological, and the method pursued must be the same as that employed in dealing with other fossil remains.—*Professor Huxley in the "Nineteenth Century."*

New Books to be Read (or avoided)—and Why.

Donovan: A Modern Englishman. By Edna Lyall. (London: Hurst & Blackett.)—From the first page, with its impossible school scene, to the last chapter, with its preposterous change of a freethinking but semi-idiotic card-sharper into a believer in all the details of a specific religion, this book is a collection of absurd incongruities. Except for the scene of the death of Donovan's little sister, there is nothing in the story in which a full-grown mind can take interest. A schoolgirl's ideas of what a freethinker might be, of the ways and manners of card-sharpers, of the possible iniquities of designing relatives, of the method of training for the medical profession, and so forth, may be curious, and are certainly amusing; but they can hardly be interesting. This book will be attractive to those who imagine free-thought to be a sort of wild rebellion of mind against all that is sweet and lovely and goody-goody: just as the same class of mind delights in recognising such methods of reconciliation—save the mark!—as Mr. Drummond has tried to arrange between the tenets of a prevalent form of dogmatic religion and the doctrines of science. We are drawing no parallel, we need hardly say, between the mystical imaginings of Mr. Drummond and the incoherent absurdities of the young lady who writes under the assumed name of Edna Lyall. But such books are attractive to the same class of readers, and for the same reason. They supply the same (to them) satisfactory answer to their touchingly pathetic question, "Oh, *why* won't thinking men still accept with childlike blandness the sweet teachings of the pastors of their boyhood?" For grown folk such books are about as suitable as a diet of pap would be for the pioneers of a continent.

Dictionary of National Biography. Edited by Leslie Stephen. Vol. VI.—Bottomley-Browell. (London: Smith, Elder, & Co. 1886.)—Mr. Leslie Stephen's noble undertaking, which cannot fail hereafter to rank among our British classics, shows no falling off either in its matter or manner. The present volume exhibits the same catholicity of selection and the same judgment in the treatment of the biographies of which it is composed that have distinguished its predecessors. Concise where the limited interest of its subject demands conciseness, and fuller and more rich in details where fulness is called for, these lives are the very models of what they should be. The man of science will here find all that he needs to know concerning Boulton (Watt's partner); Bourne, the mathematician; Boyle, the chemist; Bradley, the third Astronomer Royal, whose biography by Miss A. M. Clerke is really admirably written; Brande, the chemist; Briggs, the first computer of logarithms to the base 10; Brindley, the engineer; Sir T. M. Brisbane, the astronomer; T. A. Brown, the meteorologist, &c. &c.; while the lives of Alderman Boydell, the printseller of our great-grandfathers' days; Brassey, the contractor; and that of Lord Brougham, of whom it was sarcastically said that "if he only knew a little law he would know a little of everything," illustrate that catholicity of selection of which we have spoken above. No library of reference can in future be held to be complete which does not possess this *magnum opus* of Mr. Stephen.

Accounts of the Gypsies of India. Collected and Edited by David McRitchie. (London: Kegan Paul, Trench, & Co. 1886.)—To every one who has either served or been permanently resident in India the words "gypsies of India" will call up the reminiscence of the race of Bunjáras, who are partly carriers, partly poachers, and wholly thieves, and who, with their long strings of pack-bullocks, their complexion—dark even for India—and their bizarre costume, form so picturesque a race of vagabonds. The author of the first part of the most curiously miscellaneous work before us, Professor de Goeje, however, applies the term Zotts, or Jauts, to the tribes which he seems to regard as the Indian gypsies, and in which he includes certain jugglers, bearleaders, and the like. He apparently considers these Jauts as descended lineally from the Medes. It would seem as though M. de Goeje's acquaintance with India were limited to the North-West Provinces. His text is illustrated—or contradicted, as the case may be—by numerous notes in an appendix furnished by Mr. McRitchie. Then the siege of Bhurtpoor is lugged in, for no other reason that we can discover than that the defenders of that famous fortress were Jauts. Two chapters on "Remarks on certain Gypsy Characteristics" and "Miscellaneous Remarks" complete the volume. That matter of interest is enshrined in it we are not concerned to deny; but on rising from its perusal we feel that its prevailing characteristic will be best expressed in the words of the Scottish idiot, who, having read a dictionary through from beginning to end, closed it with the remark that "it was a vair' disconnectit buik."

British Petography. By J. J. Harris Teall, M.A., F.G.S. Parts II. and III. (Birmingham: Watson Brothers & Douglas.)—Petography, or the study of the intimate structure of rocks, almost owes its being in its existing form to Mr. Sorby, whose masterly microscopical researches have placed this indispensable adjunct to the knowledge of the field geologist upon a truly scientific basis. Mr. Teall, in the carefully executed work before us, accurately describes the minute structure of the different rocks of which he treats, and amply illustrates such description by capitally executed chromo-lithographs from slides of the rocks themselves as seen under the microscope, both by ordinary and polarised light. Woodcuts, too, illustrating peculiarities of structure, are scattered through the text. The nature of the minerals and the mode of their inclusion in rock masses, often throws a welcome light upon the method of their original formation; and, viewed in this relation, Mr. Teall's book will be found valuable to all engaged in the work of personal examination of the materials forming the earth's crust.

The Rotifera or Wheel Animalcules. By C. T. Hudson, LL.D. Cantab., assisted by P. H. Gosse, F.R.S. Parts II. and III. (London: Longmans, Green, & Co. 1886.)—If, on being introduced to a stranger, we were suddenly to see his face begin to rotate about an axis passing horizontally through his nose, we could scarcely behold so surprising a spectacle with more blank amazement than did old Leeuwenhoek feel when, towards the end of the seventeenth century, he obtained his first sight of the wheel animalcule under his microscope. For, with the optical means at his disposal (and, in fact, with more refined apparatus still), the effect of a creature the lobes of whose head were seemingly rapidly turning round like toothed wheels, might fairly cause any observer to doubt the evidence of his own senses. And in this particular case the doubt would have been wholly justifiable, inasmuch as we now know this effect of seeming rotation to be an optical illusion, having its origin in the motion of innumerable "cilia" fringing the discs which form the head of the creature, and producing a deception akin to that caused by the revolving cups of an anemometer, the Zoëtrope, &c. &c. As we have not seen the first part of

Dr. Hudson and Mr. Gosse's magnificent work, we are ignorant of the particular form of rotifer which they select as their typical one; but, for our present purpose, we may take that very common one, the Rotifer vulgaris, and ask the reader, who approaches the consideration of this subject for the first time, to picture to himself an aquatic animal allied to a worm, having a transparent body about one-fiftieth of an inch in length. It has two small round red eyes, two teeth (whose constant movement in triturating the food swallowed by the creature was mistaken by Leeuwenhoek for the pulsations of its heart!), a stomach, with surrounding gastric glands, a contractile vesicle, and a nervous system, a triangular ganglion of which serves the rotifer for a brain. The variety of form, however, in this marvellous group of creatures is almost inexhaustible, and as far as their external appearance is concerned, numbers of them have scarcely anything in common save the trochal disc, or wheel organ, and even that assumes the most diverse forms in various genera and species (e.g. Synchæta and Stephanoceros). Our authors have addressed themselves to the description and illustration of the entire class of these strange organisms, and most admirably and thoroughly are they performing their task. Of the correctness and beauty of the illustrations it would be impossible to speak in too high terms. We are stating a very plain and sober truth when we say that, for the purposes of the student, they are perfect. Every microscopist at a loss for a most interesting employment of his instrument, alike with every student of biology and zoology, should procure this superb book. In fact, a microscopical library is as incomplete without it as would an ordinary one on whose shelves neither the Bible nor Shakespeare found a place.

A Short Manual of Chemistry. Vol. I., Inorganic Chemistry. By A. DUPRÉ, Ph.D., F.R.S., &c., and H. WILSON HAKE, Ph.D., F.C.S., &c. (London: Chas. Griffin & Co. 1886.)—The conspicuous merit of this treatise on chemistry by Drs. Dupré and Hake is that it begins at the very beginning, and takes no preliminary knowledge whatever for granted on the part of the student. The introductory chapters are particularly good, and the information generally brought down to the very latest date.

Arithmetic for Schools. By the Rev. J. B. LOCK, M.A. (London: Macmillan & Co. 1886.)—Mr. Lock very wisely avoids crowding his book with rules, and gives examples worked out at length instead, The theory of the operation to be performed is, however, always stated. He has obviously taken immense pains with this work, which seems well adapted to the purpose for which it was designed.

The Elements of Economics. By HENRY DUNNING MACLEOD, M.A. In two vols.—Vol. I. (London: Longmans, Green, & Co. 1881.)—There is a species of superstition, more or less widely diffused, that with the universal establishment of Free Trade, political economy would practically cease to have any *raison d'être*; but, as Mr. Macleod points out in the masterly work before us, this amounts to regarding the science of economics as simply a destructive one, and ignoring it altogether in its constructive or positive aspect. No one could or would for an instant deny the yeoman's service rendered to economical science in the past by such representative men as Adam Smith, Ricardo, and John Stuart Mill, but in many material respects they stood much in the same relation to the more scientific economists of the present day as Stahl with his "Phlogiston" did to Priestley and his successors. In reviewing the second volume of the work now before us, on p. 192, we expressed the opinion that "if the previous portion of the book before us is as sound in its inferences and apposite in its illustrations as the one before us, it, as a whole, constitutes a valuable and important contribution to economical science;" and we are happy to find, on perusing the first volume, that our hypothetical estimate of its value is thoroughly justified. A ripe scholar, possessing information of the most varied and extensive character, and an enthusiastic admirer of the Baconian philosophy, Mr. Macleod has employed the inductive method to build up a system of economics which must render his book a classic, be the future developments of the science what they may. His originality and wealth of illustration render his volumes readable even by those to whom their title conveys little beyond the idea that they must treat of a very dry subject. Anyone possessed by such a notion who will open them will find himself agreeably disappointed.

Coffee: Its Cultivation and Profit. By EDWIN LESTER ARNOLD. (London: W. B. Whittingham & Co. 1886.)—At a time when coffee-planting in Ceylon spells "periodical bankruptcy," a book on the "Cultivation and Profit" of what was at one time the staple of the classical Taprobane may well appear, at the first blush, superfluous. Mr. Arnold, however, points out in the eminently practical work before us that a vast area of heretofore uncultivated land is in existence upon which coffee could be grown at a handsome profit, and in his concluding chapter on "Coffee Countries" he shows over how wide an area of the earth's surface remunerative crops of this valuable plant might be grown. The minute and explicit directions for coffee culture, which form the main portion of the volume, are obviously the work of an expert whose personal experience embraces the most recent methods of cultivation and curing. Coffee-planters who wish to make the most of their existing estates will certainly buy the book; while it may, further, be commended to adventurous young men in search of a pleasant and healthy occupation.

Gesta Christi: a History of Human Progress under Christianity. By C. LORING BRACE. (London: Hodder & Stoughton.)—By gathering all the progress of humanity during the last eighteen centuries to Christianity, and all religious hatreds and persecutions to the Church, Mr. Brace seems to make out a very strong case. The Catholic Church seems to make out an even stronger case when attributing all progress to the Church and all evil to freedom of inquiry. Science, did she care for it, might make out a much stronger case than either—a case, also, really not apparently strong—by showing the actual nature of progress among the Indo-European races during the last 2,500 years.

James Nasmyth, Engineer: An Autobiography. Edited by SAMUEL SMILES. New Edition. (London: John Murray.)—We are glad to see a new and cheaper edition of this most interesting and instructive work. There is more real religion in the life of such a man as Nasmyth than in the lives of a thousand dreaming, hysteric "saints." We shall have occasion to make further reference to this valuable book before long.

Modern Whist. By CLEMENT DAVIES. (London: Sampson Low, Marston, & Co.)—This little treatise on whist is reserved for review by "Five of Clubs." It should be good to justify its price. We have here a work of 96 pages, whereof all but 41 either belong to title, preface, and the laws (quoted *verbatim*), or are blank; the 41 pages of original matter average 170 words per page. The price of the book is four shillings. Comparing this with the contents and price of "Cavendish," and still more with those of "How to Play Whist," by "Five of Clubs," it will be seen

that Mr. Davies thinks that a very little of his whist will go a long way. In "Home Whist," by "Five of Clubs," there are 80 pages, of which 72, averaging 230 words, are occupied with original matter. It would thus appear that "Five of Clubs" considers one shilling a fair price for 16,000 words of original matter, while Mr. Davies values at four shillings 7,000 words of original matter *plus* about as many words of matter which Clay, Cavendish, Pole, Drayson, and others, have already thrown into their works almost for nothing.

Trigonometry for Beginners. By J. B. Lock. (London: Macmillan & Co.)—A capital little book, thoroughly sensible and practical. It extends only to the solution of triangles, a very proper limitation.

The Definitions of Euclid, with Explanations and Examples. By R. Webb. (London: George Bell & Sons.)—A simple and suggestive study of the definitions. A student who has thoroughly mastered the subject-matter of this treatise will find the study of the problems much simplified for him.

Class-Book of Geology. By Archibald Geikie. (London: Macmillan & Co.)—This is a book which we hope to review in full ere long (in company with the book next mentioned). But we must not delay recognition of its great value. We know of no work giving a clearer or more impressive idea of the history of the Earth as recorded in her crust. Professor Geikie's descriptive style is simply perfect.

Outlines of Geology. By James Geikie. (London: Edward Stanford.)—Fuller in details, this work of Professor Geikie's is but little inferior in literary excellence to his brother's admirable work. It serves as a convenient middle step between that book and Professor A. Geikie's larger treatise, already noticed in these columns.

Mythical Monsters. By Charles Gould. (London: W. H. Allen & Co.)—A capital book, showing that many monsters regarded as mythical are in reality not mythical at all. We propose to give a full review of this most interesting work in an early number.

Flowers, Fruits, and Leaves. By Sir J. Lubbock. (London: Macmillan and Co.)—A charmingly written and well illustrated little work, showing the origin by evolution of many of those wonderful "evidences of design" on which the theologians of a century ago were so fond of dilating—limited knowledge enabling them to imagine but one interpretation. Sir J. Lubbock writing about science is a very different man from Sir J. Lubbock on a hundred books.

The Springs of Conduct: An Essay on Evolution. By C. Lloyd Morgan. (London: Kegan Paul & Co.)—An excellent and most interesting exposition of the growing doctrine of the evolution of conduct. Reserved for fuller review when space permits, which will be soon.

Lewis's Pocket Medical Vocabulary. (London: H. K. Lewis. 1886.)—Mr. Lewis's little book will be found useful, not only by the medical practitioner, but also by all engaged in the administration of those branches of the criminal law into which medico-legal questions enter. In fact, it will even be found handy by that numerous class which revels in the reports of murder-trials and of coroners' inquests in the daily papers, by adding to its appreciation of the meaning of much of the seeming jargon which appears as evidence. At once full and concise, we have but one trivial fault to find with the work before us. It is that its compiler is here and there somewhat hazy in his "quantities." For example, he speaks of Ab'domen, the correct pronunciation being Abdo'men. In the same way we find Ver'tigo for Verti'go—and so on. The classical reader will of course correct all this for himself.

The Legal Guide for Landlords, Tenants, and Lodgers. By J. T. Akerman, Esq. (London: Griffith, Farran, Okeden, & Welsh.)—This is a pamphlet whose value is out of all proportion to its very small price and unpretending aspect. It contains, in a compendious form, everything that need be known by a layman on the subject of the relations existing between the landlord and his tenant; and no one should either let or take a house, furnished or unfurnished, or even lodgings, without a careful study of the law as simply laid down in a manual as cheap as it is sound.

The Tourist's Guide to the Flora of the Alps. By Professor K. W. v. Dalla-Torre. Translated and Edited by Alfred W. Bennett, M.A., B.Sc. (London: Swan Sonnenschein, Le Bas and Lowrey. 1886.)—This admirably compact work, in its form of a tuck pocket-book, will be found invaluable by the botanist and plant-collector in the Alps. Carried easily in one of the smaller pockets of a shooting-coat, and most conveniently arranged for reference, it is the very book for everyone for whom the strange Alpine flora possesses any charm. To all such we commend it.

Latin Prose Composition. By the Rev. Herbert W. Sneyd-Kynnersley, LL.D. (London: Relfe Brothers.)—This is one of the innumerable successors to the "Ellis's Exercises" of our childhood. Dr. Kynnersley seems to have done his work conscientiously and selected his examples judiciously.

Walford's Antiquarian. Edited by Edward Walford, M.A. April 1886. (London: George Medway.)—All who delight to live in the memories of the past should read Mr. Walford's charmingly chatty magazine, which brings pleasantly before us so much that is good, beautiful, amusing, and interesting in times long separated from our own.

The Vegetable Garden. By MM. Vilmorin-Andrieux, of Paris. English Edition, published under the direction of W. Robinson, Editor of "The Garden." (London: John Murray. 1885.)—Assuredly there is no such an encyclopædia of esculent vegetables in existence as the exhaustive one whose title heads this notice; containing, as it does, admirably executed drawings and full descriptions of every garden vegetable used for the food of man in temperate climates, together with explicit directions for its cultivation. To the gardener, be he professional or amateur, to the gourmand, and very notably to the vegetarian, MM. Vilmorin-Andrieux's book is simply indispensable; while the general reader will learn with some amazement from its pages how numerous and delicious are the plants grown for the table, of whose very names he has previously been in ignorance. Our authors have conferred a real service upon all who are anxious for variety in their diet, as well as upon those to whom we have to look for its production.

The Artist's Manual of Pigments, by H. C. Standage (London: Crosby Lockwood & Co. 1886), is a book calculated to be of the greatest possible service to all artists, and more especially to those just beginning their career, and to art students. The deterioration in hue of modern

pictures as compared with those of the old masters is very apparent even to the unprofessional eye, and the reason of this is to be found in the fact that most modern painters are ignorant of the chemical composition and reactions of the pigments they employ, and therefore not only use impure pigments adulterated by the trade, and sold to supply the demand for cheap materials, but also make dangerous immixtures of pigments and vehicles, so that their pictures become in reality self-destructive. In his present valuable little work Mr. Standage gives the chemical name and composition of each pigment, with particulars as to its artistic use, the conditions under which it is permanent or non-permanent, the general adulterations and the tests for the discovery of these, and adds a most useful chapter on reactions between two or more pigments and between pigment and vehicle, &c. Another chapter is on mixtures of pigments, to produce various colours; and he also gives very good advice as to the respective value of different pigments for use in portrait, flower, and marine paintings. The remarks made in Chapter VIII. as to the necessity of making a scientific nomenclature and scales of colour are very much to the point. When we come to define a tint or colour, we are almost invariably at a loss for words, and some convention should certainly be made on this important subject. The matter should be taken up by the Royal Society or the Society of Arts, and Mr. Standage's suggestion that the hues of well-known fruits or flowers should be taken to form the foundations of scales of colour is a very feasible one.

Dogs, in Health and Disease, as Typified by the Greyhound. By JOHN SUTCLIFFE HURNDALL, M.R.C.V.S. (London: E. Gould & Son. 1886.)—The medical system advocated in this work is homœopathic, and very full and explicit directions for the treatment of every canine ailment on that system are given by Mr. Hurndall. Whether agreeing with the doctrine of Hahnemann or not, the dog-owner may, however, glean some useful information from these pages, as it is pretty obvious that the author has entered deeply into the question of canine pathology, and has an intimate personal acquaintance with the various types of disease which afflict man's faithful companion.

The "Competitive Examination Papers" in Pure Mathematics (Stages I.–III.). By N. C. POTTER. (London: Moffatt & Paige.)—Loaded up to the muzzle, like an overcharged gun, and then let off at his "exam.," the miserable competitor but too often quits the examination room as empty as the discharged gun to which we have likened him. Just so long, however, as the present system exists will the miserable system of cramming survive too; and if we are to admit the necessity of the evil, Mr. Potter's little book will enable the student to fill his mind effectually with the kind of "knowledge" which passes muster in Cannon Row and at South Kensington.

Bemrose's New Code Drawing Cards, Second and Third Series. (London: Bemrose and Sons.)—These cards contain "copies" for students, the first set curved forms for free-hand drawing, and the second geometrical figures. They fulfil the requirements of the "Science and Art Department," which is presumably what they are intended for.

A Manual of Mechanics. By T. M. GOODEVE, M.A. (London: Longmans, Green, & Co. 1886.)—In simple language and formulæ, illustrated by equally simple examples, Mr. Goodeve introduces the beginner to the elements of mechanical philosophy. As may be expected from so thorough a master of his subject, nothing is omitted which will smooth the path of the young student; who is led on step by step until, with the most moderate attention on his part, he possesses a competent knowledge of the elements of applied mechanics, and is in a position to attack works of a higher and more pretentious character. This is a capital little book.

Notes on School Management. By GEORGE COLLINS. (London: Moffatt & Paige. 1886.)—Mr. Collins's book will be found useful by teachers in public elementary schools, as also by the managers of such schools; in fact, by all interested in elementary education. It contains a large quantity of well-arranged information.

AN OLD MISTAKE CORRECTED BY MODERN SCIENCE.—While Science is quite unable to say definitely the order in which the several races actually *began*, she is able to say most positively that these several races did not *come into existence as races* in any order whatsoever. Not to consider for a moment the absolutely overwhelming argument when mammals are compared with, say, reptiles, or vertebrates with insects, or either with molluscs, and to put on one side the still more crushing argument from the comparison of animal with vegetable life, take the case of two existent species—men and horses. Science cannot determine whether man came before the horse, or even say where, along the lines of development from anthropoid apes to man on the one hand or from the Eohippus to the horse of to-day on the other, it could truly be said that man or horse had actually appeared on the earth. But science can say most positively that neither did the development of the horse precede that of man, nor, *vice versâ*, did the development of man precede that of the horse. Both developments went on together—this being no theory, but the direct teaching of the records contained in the later tertiary and earlier quaternary strata of the earth. The very natural mistake of the old Babylonian folk, which quite as naturally their much less intelligent Jewish captives were not able to detect and correct, lay in supposing that not merely whole species, but whole *genera*, were formed at once, each being fully completed before the next took its turn. Whether the completion of each required a day of twenty-fours hours, as theologians once taught, or a period of indefinite length, as they are good enough to assume now (being obliged), this mistake shows that those who made and maintained it really knew nothing about the origin of life, animal and vegetable, upon this earth. As, indeed, how *should* they? What an absurdity it is, if we come to think of it, to make our interest in the old Hebrew writings depend in the slightest degree on the question whether the old Accadians, to whom the earliest records in the cuneiform inscriptions were due, really knew what it has taken modern races, who have specially devoted themselves to the inquiry, many centuries of research to ascertain!

M. RENAN AND THE BIBLE.—What M. Renan has said with regard to the literature of the ancient Hebrews (considered by them, and accepted by other than Hebrew races, as sacred) is fair enough when he is considering its history. He points out clearly, for instance, what every competent judge must notice, that some books are altogether inferior to the rest, and even "mere *réchauffés*, very unintelligently done, from the ancient histories." This description applies in particular to the two books of Chronicles, as any one will find who carefully compares these with the corresponding parts of the books of Samuel and of Kings. The books of Ezra and Nehemiah show similar shortcomings. But in dealing with ancient literature as a whole, M. Renan is unfair to modern literature in regarding the Hebrew and the Hellenic literatures as the two sole "sources of unconscious and impersonal beauty" for the world. "The literary history of the world," he says, "is the history of a double current, which has descended on the one side from Homer to Virgil, on the other from the Hebrew Bible to Jesus. Since then we have lived upon them." If this is meant only in the same sort of sense as—for example—one might say "Newton owed all the scientific power which has made his name illustrious to his father and mother," one need take no exception to the remark. A Shakspeare and a Goethe may be the mental offspring of the Aryan and Hebrew stocks of poetry. But M. Renan's words imply much more than this. They suggest that in his opinion the literature of modern times (i.e. of times since Virgil and Jesus) has been no more than a re-working of the material collected by the older writers—the Isaiahs, Jeremiahs, Hesiods, and Homers, of old races. This is not only a paradox, but a most perverse one.—*Newcastle Chronicle.*

MEASUREMENT OF STELLAR LUSTRE.*

THE *Uranometria Nova Oxoniensis* is a valuable work, though not equal in accuracy to the admirable survey by Professor Pickering. The method adopted by Professor Pritchard is indeed not susceptible of exact accuracy, though sufficiently accurate for the purpose in view. Seventy thousand instrumental measures were made with the wedge photometer by Messrs. Plummer and Jenkins, the real authors of this excellent work, and all stars visible to the naked eye, from the North Pole to ten degrees south of the equator, are included in the survey. The title-page bears the name of Professor Pritchard, who is supposed to have overlooked the work, and who certainly overlooked certain serious defects in the method of observation. These, however, have been sufficiently indicated by Professor Pickering, whose more numerous and exact observations, actually conducted by himself personally, make his opinion authoritative in such matters. No astronomical library would be complete, however, without the excellent work containing the results of the survey of the northern heavens by Messrs. Plummer and Jenkins.

MR. RUSKIN ON THE BIBLE.—Mr. Ruskin has written the following letter, as his rather questionable tribute to the literature of the ancient Hebrews:

St. Mark's Day, 1886 (Easter Sunday).

Sir,—Will you allow me, rather from Venice, in thought, than from poor little Brantwood, in body, to send you one quite serious word, for the close of my part in your book discussion? I see in your columns, as in other literary journals, more and more buzzing and fussing about what M. Renan has found the Bible to be, or Mr. Huxley not to be, or the bishops that it might be, or the School Board that it must not be, &c. Let me tell your readers who care to know, in the fewest possible words, what it is. It is the grandest group of writings existent in the rational world, put into the grandest language of the rational world in the first strength of the Christian faith, by an entirely wise and kind † saint, St. Jerome; translated afterwards with beauty and felicity into every language of the Christian world; and the guide, since so translated, of all the arts and acts of that world which have been noble, fortunate, and happy. And by consultation of it honestly—on any serious business, you may always learn—a long while before your Parliament finds out—what you should do in such business, and be directed perhaps besides to work more serious than you had thought of. For instance, I meant this morning only to have written some autobiography, but as it was St. Mark's Day, reading his first chapter, it struck me, if perchance anybody in this pious nation—proposing this year to effect sundry changes in its hitherto all-vaunted constitution—wished in their Easter holidays to baptise themselves, confessing their sins, and abjuring them in a cheerful and hopeful manner—what sort of streams could they find to baptise themselves in near most country towns? I observe, sir, you have complimented our—for the time reposing—Parliament on its hitherto devotion to business. I have not myself noticed much that it has done to any purpose, except virtually abolishing the Act against pollution of rivers. Which repentance of theirs virtually signifies that the management of the millennium we have presently to look for is to be put in the hands of the sort of British patriot who is ready to poison the air, and the wells, for his neighbours, a hundred miles round, and to sit himself all his life up to his throat in a—[really Mr. Ruskin indulges in somewhat strange illustrations, and in his Biblical enthusiasm uses words unpleasing to ears polite], so only that he may lick up lucre from the bottom of it.

---

* *Uranometria Nova Oxoniensis.* A photometric survey of the stars visible to the naked eye at Oxford, carried out at the Oxford University Observatory, by Messrs. W. E. Plummer and C. Jenkins. By [?] Professor Chas. Pritchard. London: H. Frowde.

† As a sample of the saint's kindly wisdom, one may quote from his letter to Marcella; where, speaking of those who objected to his correction of words in the Gospels, he says, "I could afford to despise the poor creatures (*homunculos*); for a lyre is played in vain to an ass." Jerome's kindness was akin to Mr. Ruskin's modesty.

THE FACE OF THE SKY FOR JUNE.

By F.R.A.S.

THE sun may still be examined, as occasion offers, for spots and faculæ. Map vi. of "The Stars in their Seasons" gives a representation of the night sky. In one sense, however, there is no real night in any part of the United Kingdom during the month of June, inasmuch as twilight persists from sunset to sunrise. Mercury, as a morning star, is poorly placed for the observer during the first part of June, in fact, he comes into superior conjunction with the sun—or is, so to speak, behind him—at 2 A.M. on the 12th. After this, though, he becomes an evening star, and towards the end of the month may be seen with the naked eye twinkling like a star of the 1st magnitude over the W.N.W. horizon. Venus is a morning star throughout June, but is getting smaller daily, and her beautiful crescent has given place to a gibbous figure, which renders her a much less interesting object in the telescope. Mars is becoming an insignificant object, but may be seen in the west when it gets dark as a big red star. He travels from Leo into Virgo, and on the nights of the 22nd and 23rd will be just south of β Virginis ("The Stars in their Seasons," map v., or "The Seasons Pictured," plate xxv.) At 10 o'clock in the morning, on the 28th, Mars and Jupiter will be in conjunction. The minor planet Juno may now be picked up to the S.W. of η Serpentis at the beginning of the month, whence it travels towards ζ in the same constellation ("The Stars in their Seasons," map vii.) She looks like an orange-coloured star of the 8th magnitude. Pallas may be seen, too, as a yellowish 7th mag. star, very sharply defined. Towards the end of June she will be among some of the 6th mag. stars, in the south-eastern part of Hercules. Jupiter is getting towards the west, and must be looked at as soon as it is dusk. He is in "quadrature" or 90° removed from the sun at 10 A.M. on the 18th; and although he is at far too great a distance to exhibit phases or to look actually gibbous, as Mars does, yet a perceptible shading will be seen on his following limb. He is situated somewhat to the east and north of β Virginis, and travelling towards η ("The Stars in their Seasons," map v., or plate xxv. of "The Seasons Pictured"). Twilight &c. diminishes the number of fairly observable phenomena of his satellites, but enough remain to supply the student with some interesting work. To begin with, Satellite I. will be occulted on the night of the 1st at 11h. 36m. P.M. On the 2nd the shadow of this same satellite will enter on to Jupiter's face at 8h. 56m. P.M.; the satellite casting it will pass off Jupiter's opposite limb at 11h. 12m., and the shadow 25 minutes after midnight. On the 3rd, Satellite I. will reappear from eclipse at 9h. 31m. 27s.; and Satellite II. begin its transit at 11h. 51m. P.M. On the 5th, Satellite II. will reappear from eclipse at 12h. 13m. 26s. P.M. On the 9th, Satellite I. will enter on to Jupiter's face at 10h. 49m. The same satellite will reappear from eclipse on the 10th at 11h. 26m. 12s. P.M. On the 11th, Satellite III. will be eclipsed at 9h. 54m. 53s. P.M. On the 12th, Satellite II. will be occulted at 9h. 32m. On the 18th, Satellite III. will be occulted at 8h. 31m.; Satellite I. will pass off Jupiter's face at 9h. 29m., as will its shadow at 10h. 44m. P.M. Satellite IV. will be occulted at 10h. 10m. on the night of the 19th. On the 25th, the ingress of the shadow of Satellite I. will occur at 10h. 24m.; and lastly, on the 26th, Satellite I. itself will reappear from eclipse at 9h. 44m. 33s. P.M. Saturn and Neptune are both invisible, but Uranus may still be seen, as soon as ever it is dark enough, just south of η Virginis ("The Stars in their Seasons," map v., or "The Seasons Pictured," plate xxv.) The moon is new at 1h. 55·3m. P.M. on the 2nd; enters her first quarter at 7h 26·7m. in the morning of the 9th; is full at 1h. 38·9m. in the early afternoon of the 16th, and enters her last quarter at 4h. 35m. P.M. on the 24th. Four occultations only, and those of small stars, are visible at tolerably convenient hours during the present month. On the 9th B. A. C. 4,043, a star of the 6½ mag. will disappear at her dark limb five minutes after midnight at an angle of 74° from her vertex. She will be setting at its reappearance. On the 19th, before she has risen B. A. C. 7,145 of the 6½ mag. will have been occulted by her bright limb. Later it will reappear at her dark limb at 10h. 18m. at a vertical angle of 186°. On the 20th B. A. C. 7,487 of the 6½ mag. will disappear at the bright limb at 12h. 36m. P.M. at an angle of 89° from the vertex of the moon. It will reappear at her dark limb at 1h. 55m. the next morning, at an angle of 258° from her vertex. Finally, on the night of the 23rd, 24 Piscium, a 6½ mag. star, will disappear at the moon's bright limb at 12h. 43m. at an angle from her vertex of 87°, reappearing at the dark limb at 1h. 47m. A.M. on the 24th, at a vertical angle of 241°. At noon to-day the moon is in Taurus ("The Seasons Pictured," plate xxiii.), through which

constellation she is travelling until 2h. 30m. P.M. on the 3rd, at which instant she crosses into the narrow northern strip of Orion. By 2 o'clock the next morning she has traversed this and entered Gemini ("The Seasons Pictured," plate xxiv.) Her passage across Gemini occupies her until 4 P.M. on the 5th; and then she passes into Cancer. At 3 A.M. on the 7th she quits Cancer for Leo; as she does Leo, in turn, for Virgo, at 3 P.M. on the 9th ("The Seasons Pictured," plate xxv.) By 5 P.M. on the 12th she has travelled across Virgo and passed into Libra ("The Seasons Pictured," plate xxvi.) Having completed her journey through Libra, at 3 P.M. on the 14th she arrives at the narrow northern strip of Scorpio. She takes 9 hours to cross this, and emerges in the southern part of Ophiuchus at midnight. On the 16th, at 7 P.M., she leaves Ophiuchus for Sagittarius; whence, at 8 A.M. on the 19th, she crosses into Capricornus. She leaves Capricornus for Aquarius at 7 A.M. on the 20th ("The Seasons Pictured," plate xxi.), her passage across Aquarius occupying her until noon on the 23rd, when she enters Pisces ("The Seasons Pictured," plate xxii.) She is occupied until 6 P.M. on the 26th in traversing this great constellation, and at the hour just named passes into Aries ("The Seasons Pictured," plate xxiii.) At 10 A.M. on the 28th she leaves Aries for Taurus. In pursuing her path through the last-named constellation she once more arrives, at 11h. 30m. on the night of the 30th, on the boundary of the narrow northern strip of Orion. She is, of course, in this outlying portion of Orion at midnight.

WHIST.

By "Five of Clubs."

In the following sketch of a game we compare the way in which a scientific player and the old-fashioned family whist-player regard and deal with a particular hand. The question of the advantage or propriety of signalling does not come in; at any rate, nothing is gained by the only player who actually signals, but, on the contrary, he obviously loses ground through his signalling.

I am, let us suppose, the third player; my partner, therefore, having to lead. I find on examining my cards that I hold Queen and two small trumps (Clubs); King and three small cards in my best plain suit (Spades); Queen, Knave, and another card in another plain suit (Hearts); and in the remaining suit (Diamonds) I hold Ace and two small cards. The trump card is a small Club. This is a good hand, though many would be discontented with it, as there is nothing very striking in its strength. I am rather short, it is true, in trumps, and if my King falls in Spades I can do nothing in my best suit; but with fair luck in the fall of the cards, and if my partner has a tolerably good hand, we ought to be able to hold our own against the enemy, for I have a fair amount of protection in the other plain suits. Still, if the enemy are strong in trumps, and have a long and strong plain suit, matters may go rather heavily against us. That is the view which the player of whist takes of such a hand. The family whist-player, on the other hand, considers that he will surely make his Ace of Diamonds, and probably his King of Spades and one of his Queens, and there his ideas about such a hand stop.

Now suppose my partner leads the King of Diamonds: then I know he holds the Queen also, and most probably two more. If he only holds one more, probably he holds four trumps and three cards in each of the other suits. The player on my right drops the Nine; I and the fourth player two small cards. My partner leads the Seven of Diamonds, player on my right drops the Four, I play the Ace, and player on my left drops another small card: but the Six of Diamonds has not yet fallen. To the family whist-player holding such a hand as mine, and also playing as I have done (for he could do no otherwise), the game is no more developed now than it was at the beginning. He would be troubled about making his King of Spades, as he had already made his Ace of Diamonds: but would have no idea how the cards lay. But the game has in reality been much developed, and the proper strategy clearly indicated. I know, if I understand whist and have been duly observant, a number of things. In the first place, the player on my right is strong in trumps, for he has signalled his partner to lead them at the first opportunity. Next, I know that my partner has the Queen of Diamonds, and not *both* the Knave and the Six. If he is a follower of the new American rules he may hold the Six, and have played the Seven as his fourth best card: but in that case he does not hold the Knave, for, had he done so, the Knave (from five cards in the suit, headed by King, Queen, Knave) was the right card to play. The Six certainly does not lie on my right. The chances are that either the Six or the Ten, or the Knave, or both Six and Ten or Six and Knave, lie on my left. Therefore, if I lead my partner's suit, the chances are that I compel the player on my right to trump—my partner still remaining with the best card of the suit, and perhaps with both the remaining cards. Now this is precisely what the family whist-player would religiously avoid. "What! give my foe the chance of trumping!" he would say. "Most assuredly not, if I know it." He would lead his lowest Spade, the chances being two to one that the enemy would make the trick, bring in trumps, and probably make a number of tricks in Hearts, which are certainly their strong plain suit. The family whist-player would be quite unconscious that he had brought disaster on himself and on his ally by losing the chance of forcing the adverse strong trump hand.

I lead, however, my partner's suit; he heads the second player, and fourth player trumps. So much is certainly good for our side. Possibly that strong trump hand on my right may have been so far weakened that he will not now lead trumps. But it appears that this is not the case. He leads a small trump. I know now that either he originally held six, or else his plain cards are very strong, in which case I rejoice at the thought that my King of Spades lies on his left, for he probably holds the Ace. (As a matter of fact he does not, but that is a detail.) He leads a trump, then; I play a small trump; player on my left exhibits, luckily, extreme weakness—his card is the original trump card—and my partner takes the trick with the Ten. Now, what will my partner do? He knows not which is my better suit of the two plain suits unplayed. If he holds both the remaining cards of his own suit (Diamonds) he would hardly lead one; for that would be to let the weak trump hand ruff, and this is always bad. However, I find he does lead the best card of his suit. I have reason then to think that the last card of the suit lies with my enemy on the left. The case is really otherwise, and far more favourable for us. See, now, how the strong opponent is put at a disadvantage by this lead, which, to the family whist-player, seems so absurd. If he lets it pass, a trick is made, and probably the next lead will be through his strength—always unpleasant. If he trumps it, he either has to lead trumps again, which (after the weakness shown by his partner) is misery, or to lead from his strong suit at a probable disadvantage; for neither of his enemies has yet unguarded himself in either Spades or Hearts. He passes the trick. I discard a small Spade—following the proper course when the enemy has declared strength in trumps. But, aha! what is this? My opponent on the left neither follows suit nor trumps, but discards a Heart! This discloses nearly everything. I know not only that my partner holds the remaining Diamond—which is obvious, though the family whist-player, who will never condescend to count up to thirteen, might not have noticed it—but that he must hold such trumps as to have felt sure that the player on my left had no more. I know, further, that the other enemy cannot have held originally six, or he would have been well able to afford a ruff. Since, then, I held three, and the two opponents on my right and left five and one respectively, my partner held originally four trumps. We have our erst threatening foe, then, in a cleft stick! My partner equals him in length of trump suit in hand; I hold a guarded Queen in trumps, second best in Spades, and a high sequence in Hearts. We shall come out best, without question.

My partner now leads the last Diamond. Second player may please himself as to trumping it or passing it. If he trumps with anything short of his best (he does not hold *both* the Ace and the King, I know), I shall over-trump. He is in the dark as to the position of the high cards in trumps. He prefers not to disarm himself, lest haply he should lose in the play of the plain suits; for, observe, this is but the sixth trick. He passes the trick (I discarding a Heart). And now my partner, having good reason to think that it will be disadvantageous for second player to be led through in trumps, leads a small trump; Knave is put on it, and I take the trick with my Queen. I know now that my partner holds the Ace, and opponent the King. Quite probably both the remaining tricks in trumps will go to my partner, if only opponent be compelled to lead trumps at the last. (The enemy are sure to make some tricks in plain suits.) Probably my left-hand opponent, if he has any strength at all, has it in Spades. I lead a Spade, and the trick falls to my right-hand opponent's Queen. He leads a Spade, and left-hand opponent takes the trick with the Ace. A Spade is again led, which I take with my King. I lead my Heart Queen, which is captured on my right by the King. The Ace of Hearts, led on my right, makes another trick for the enemy. Then my right-hand opponent having to lead from the second and fourth best trumps, my partner holding best and third best, *both* the remaining tricks fall to my partner. We make two by tricks.

This game is a simple, and in a sense familiar, example of the value of correct play, and of the interest of a game correctly played. For, though no two games of whist are exactly alike, there are certain types of play which are often reproduced. In this game a good score was made against a strong hand by following a principle

which is repugnant to all the notions of the family whist-player—viz. leading from a suit which is exhausted in the enemy's strong trump hand. With five trumps headed by the King, Knave; four Hearts headed by the Ace, King; and a guarded Queen of Spades in one hand, with the Ace of Spades in the other, the enemy made only five tricks in all—viz. one in trumps, two in Spades, and two in Hearts. Without entering into details of play, it is certain that, had the methods of family-whist been pursued by myself and partner, the enemy would have made three tricks in trumps, two in Spades, and three in Hearts, or eight tricks instead of five—a difference of four points in scoring, since it would have altered our "two by cards" for us into "two by cards" for them.

I will not assert that the success actually achieved was *assured* by the course pursued. My judgment of the chances at the third trick, though sound in principle, might well have been inconsistent with the reality. My opponent on the left *might* have been able to ruff, the Knave lying with his partner. The odds were about five to two against this; *but* although, whenever you are sure to be right five times out of seven in following a particular course, you ought certainly to follow it, you must remember that you are equally sure to be wrong twice out of seven, in the long run, on that course. That is what the family whist-player seems unable to understand. "If you had not done so and so," he will point out, "such and such splendid results would have been obtained." And if you answer, "That was only the case because the cards chanced to lie in such and such a way, which there was no means of knowing," he will answer (or think, if he do not say it), "A bad workman complains of his tools, and a bad whist-player of his cards." But there is, in fact, nothing more certain than that, in the long run or majority of cases, you gain at whist by steadily playing according to the best view you can form of the chances, while yet you must inevitably lose by so doing in a certain proportion of games played. Thus that *crux* for the family whist-player, the lead of the King from King, Queen, and others, turns out unfavourably in about two hundred cases out of five hundred and fifty; *therefore* it is not the wrong course, but the right.

Now I think it cannot be doubted that a game played in this way, with constant attention to the various points arising as the game proceeds, and with constant reference alike to the evidence already obtained and to the chances in regard to such points as still remain in abeyance, must be a far more attractive game, and therefore far more valuable as a recreation, than that family-whist in which the only point considered is how to make, at once, all such strong cards or points as chance may have thrown into the hand.

For this reason, were there no other, I should be an advocate of scientific whist, as against the chance game called, by those who take part in it, "Whist," but more correctly—though perhaps less euphoniously—denominated "Bumblepuppy" by those who know the real game.

A GOOD JOKE, OR NONE?

If the following from the *Australasian* (in which uncommonly good whist is given, by the way) is really a good joke at my expense, I can see no reason why it should not be presented to the readers of Knowledge for their enjoyment, which may be enhanced if I mention that I retain the opinion at which the *Australasian* smiles:

"We must direct the attention of every person who can enjoy the fun of an unintentional joke to the following example with which Mr. Proctor presents his readers: The 'echo' in modern conventional whist is the intimation by which a player announces that he has been keeping his eye on the table, and has noticed his partner's 'Peter' or call for trumps. In the nature of things, then, it is evidently impossible that the 'echo' can be heard as often as the 'call' to which it is a response. Yet Mr. Proctor gravely asserts that 'occasion arises oftener for the echo than for the Peter.' This is certainly one of the most delightful examples of an unconscious blunder, of the nature of an Irish bull, with which it has ever been our good fortune to meet in a book written by an Englishman."

This occurs in a review of my "Home-whist." I hope I shall not in any way impair the joke by mentioning what I have rather insisted upon in "Home-whist," that the "echo" is enjoined by the signalling school, not only in response to the Peter, but also to the trump lead from strength. Since trumps are led from strength at least ten times as often as the Peter is displayed, it appears to me not at all miraculous that in actual play I have at least thrice as often had occasion to note the echo in either its negative or positive form, as the Peter or signal for trumps.

Some players, I may remark, scarcely ever signal for trumps—and one wishes the number were much greater, seeing that the frequent signallers are invariably bad players. Yet, so long as the present system (scarcely honest in my opinion) is followed, each of a pair of partners who both avoid the Peter is bound to echo to his partner's trump lead from strength when holding four trumps or more, unless he has definitely explained that he does not wish to follow the modern signalling methods in any respect. For if he does not, due occasion arising, he misleads his partner.

Our Chess Column.

By "Mephisto."

The nineteenth game of the recently concluded match between Steinitz, the "Champion of the World," and Zukertort, the hero of the London tournament, is in many respects a remarkable contest. The opening moves of this game demonstrate with forcible and realistic evidence the decisive advantage gained by correct play in the opening, or otherwise the opposite or disadvantageous effects produced by a faulty beginning. These are truisms for which we have always contended; but very seldom have we had an opportunity equal to the present of demonstrating these facts from the actual play of two great masters. It is a remarkable occurrence, especially considering the gravity of the occasion, that in such an important match-game the second player obtained practically a winning advantage as a result of the first nine moves. This the game will show.

Steinitz having proved himself superior in pure reasoning or mathematical play, then follows up his advantage by imaginative efforts, pleasing and vivacious in conception, and rendered all the more impressive and beautiful (to the connoisseur) by the correctness of play, based on which, the combinations are superposed. If there really was any need for demonstration, this game would furnish the proof that the highest excellence can only be obtained by a combination of pure reasoning, with imaginative combination. The stronger and truer the former, the more effective and impressive the latter. But neither quality by itself alone can elevate its possessor to that highest state of perfection which commands our admiration.

Figuratively speaking, there may yet be found many children of nature "who prefer the proverbial blue Daniel and red lions" to many a picture where the colouring is finer toned. In a less degree we find many chess-players giving preference to games, which to them seem to abound in combinations of the liveliest sort, which in reality, however, are of a more or less commonplace kind, mostly unable to endure analytical tests—i.e. resting and relying chiefly upon inferior play, a kind of performance not requiring the very highest abilities.

We cannot, however, accord to the whole match the eulogium we have bestowed upon this particular game. It was evident that both players were subject to spells of indisposition, during which they produced indifferent games; for while Steinitz, unlike himself, lost four games running by sheer blunders, Zukertort can hardly be said to have done his play justice towards the end of the match. A few very good games have, however, been played. This match, in one respect, teaches us the same lesson as the London tournament of 1883. That is this: high amounts of money do not in chess yield results relatively superior to those obtained on occasions where smaller sums were contested for. It is, of course, essential to offer substantial prizes in tournaments and matches, to induce the best possible competition; but we should much rather like to see three tournaments arranged for 1,800*l.* than one. The same remark applies to matches.

Bearing upon this subject, we may mention the efforts made at present to arrange an international tournament in London for July next, by the committee of the British Chess Association. We feel convinced that if about 300*l.* were subscribed a very interesting tournament would be arranged.

Nineteenth game of the match, played at New Orleans, March 24, 1886.

White, Zukertort.	Black, Steinitz.
1. P to Q4	1. P to Q4

(The reader will do well to take Black's side of the board.)

2. P to QB4	2. P to K3
3. Kt to QB3	3. Kt to KB3
4. B to Kt5	4. B to K2

The usual course followed in this opening by White, is to place his own game on a safe basis by castling first; whereas here White has played three moves, which Black utilised for his own development. White's K side is still blocked. Such weak points are not necessarily fatal in themselves; with care they may be redeemed, or even turned to advantage. We are, however, anxious to impress upon our readers that to have a difficult game to play is already in

itself a disadvantage. Every additional incorrect move will augment the disadvantage, not in mathematical but in geometrical proportions.

5. Kt to B3 — 5. Castles
6. P to B5

White would still have been in time for securing a safe development by playing 6. P to K3, &c. Now he offers Black an opportunity to disorganise his Queen's wing, which is weakened by the absence of the white QB, and the undeveloped state of White's K's side.

6. P to QKt3.

The proper move. If White takes this Pawn, Black would reply with RP × P, and have the advantage of the open Rook's file, which at the disposal of a Steinitz means facilities for winning a Pawn. Advantages, besides being cumulative, are also, as in this case, interchangeable. By playing P × P, White might have gained time for the development of his King's wing at the expense of weakening his Queen's side.

7. P to QKt4

There is no other alternative to playing P × P, but with every move that Black gains in development White's position becomes more precarious.

7. P × P

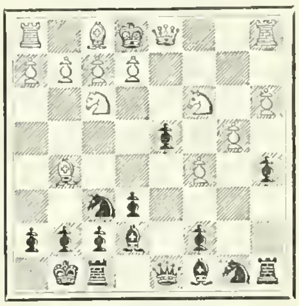
8. QP × P

If 8. KtP × P, Black might have played B to R3 in reply, preventing White's P to K3. But although White would still have had an inferior and difficult game, KtP × P was preferable to QP × P.

8. P to QR4

9. P to QR3 — 9. P to Q5

WHITE.



BLACK.

A very effective move, which gives the game a decided turn in Black's favour. Neither Kt × P nor Q × P is available in reply to this ingenious device. If 10. Kt × P, P × P. 11. P × P, R × R winning a piece. Or if 10. Q × P, P × P. 11. Q × P, Kt to R3 winning the ill-fated QBP.

10. B × Kt

In the hope that the black KB would be diverted from bearing on the white QBP, also to gain a square on K4 for the Kt, which cannot retire to Kt sq or R2 without losing a P by Black playing P × P.

10. P × B

Good judgment. The B still remains on K2 attacking the P's; the Kt could now be driven away should he play to K4, and finally Black can form a strong centre by P to K4.

11. Kt to QR4 — 11. P to K4
12. P to Kt5

Necessary in order to prevent either Kt to R3 or B to Q2, both moves being calculated to break up the Q's Pawns.

12. B to K3

This is another very deep move. White can now apparently play 13. P to B6, blocking Black's QKt and QR. But Black had his reply ready—i.e. 13. P to B6, Q to Q4. 14. P to K3, Q to Kt6 (threatening Q × Q, followed by B to Kt6). 15. B to K2 (best), P × P, with a fine game.

13. P to Kt3 — 13. P to B3

Black forces White to take the P, whereby he brings out his QKt, supports his QP to enable him to advance P to K5. If White play 14. P to Kt6 instead, both these Pawns could not resist the combined attack of Black's pieces very long, and would fall. Q to Q4 now would not be so good as in the analysis of the former note, as White would gain important time by playing 14. B to Kt2, which would prevent Black from playing B × QBP for the moment, on account of 15. Kt × B, Q × Kt. 16. Kt × P, opening on the black R, &c.

14. P × P — 14. Kt × P
15. B to Kt2 — 15. R to Kt sq. !

Avoiding possible inconvenience, and attacking at the same time.

16. Q to B sq — 16. P to Q6 !

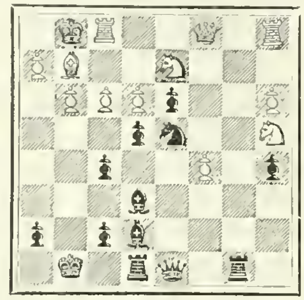
Whatever may be said of White's play, it will not be denied that Black takes advantage of it in masterly manner. If White now plays 17. P × P, Q × P would domineer White's game entirely.

17. P to K3 — 17. P to K5
18. Kt to Q2 — 18. P to B4
19. Castles — 19. R to K sq !

All things considered, White has got well over his difficulties, although considering the position of Black's Pawns, and the weakness of White's QBP, Black has a decided advantage in position for an end-game. We imagine that Black's last move was intended as a subtle waiting move :

20. P to B3 — 20. Kt to Q5 !

WHITE.



BLACK.

One of the excellent moves in which this game abounds. White, of course, need not have played P to B3. But, as we said in our introductory note, a difficult game is a disadvantage in itself, for the reason illustrated here—namely, there are so many chances of going wrong.

21. P × Kt

Black threatened Kt to K7. If White had played 21. K to R sq, Kt to B7 followed by Kt × QP, &c.

21. Q × P (ch)

22. K to R sq — 22. P to K6 !

Disdaining to take the Knight, and certainly the better part of the combination.

23. QKt to B3.

No doubt his best chance.

23. B to B3 !

This is beautiful play, especially as one fine move follows the other. If Black had played P × Kt, then 24. Q × P with less to fear than at present. Now Black temporarily gives White a chance to withdraw his piece, as will be seen, not without good reason.

24. Kt (Q2) to Kt sq — 24. P to Q7.
25. Q to B2

White could not play Kt × P without losing the other Kt as well.

25. B to Kt6

26. Q × BP — 26. P to Q8 (Q)
27. Kt × Q — 27. B × Kt
28. Kt to B3 — 28. P to K7 !
29. QR × B — 29. Q × Kt !

Resigns.

We may point out that in the whole of this game—every move of which forms a study in itself—Black has not once withdrawn any piece, not even the Queen, from the place to where it had been played to effect its purpose, except in order to advance and occupy better positions.

CONTENTS OF No. 7.

TERMS OF SUBSCRIPTION.

"KNOWLEDGE" as a Monthly Magazine cannot be registered as a Newspaper for transmission abroad. The Terms of Subscription per annum are therefore altered as follows to the Countries named :

	s.	d.
To West Indies and South America	9	0
To the East Indies, China, &c.	10	6
To South Africa	12	0
To Australia, New Zealand, &c.	14	0

To any address in the United Kingdom, the Continent, Canada, United States and Egypt, the Subscription is 7s. 6d., as heretofore.

KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART

LONDON: JULY 1, 1886.

THE UNKNOWABLE.

By Richard A. Proctor.

WORSHIP OF THE HEAVENLY BODIES.

(*Continued from page* 235.)

It is not necessary, however, to consider the indirect evidence derivable from Hebrew literature to recognise the way in which in early ages the heavenly bodies were worshipped. We have direct evidence sufficiently decisive to leave no manner of doubt on this point. I do not here refer to the astrological ideas of ancient races, clearly though these show that men regarded the heavenly bodies as influencing the fates and fortunes of men, and therefore as deities. The evidence derived from the direct association of astronomical observations with religion is more significant still, though scarcely more decisive. When we find that ceremonies manifestly relating to the religion of a people were conducted with special reference to the movements of the heavenly bodies, that structures as manifestly connected with religion were employed for astronomical observations of various kinds, that even the fears and aspirations of men with regard to a future life were associated with the movements of the heavenly bodies, we cannot doubt that the sun and moon, the planets and the stars, were the objects of religious veneration.

There may be reason to question the astronomical significance of many among the structures whose ruins are found in Egypt, Assyria, Mexico, Peru, and elsewhere; yet we find among them many so obviously astronomical in character while yet so obviously religious that they would suffice to establish the connexion between religion and astronomy in those ancient days when the movements of the heavenly bodies were unexplained and seemed inexplicable. It is, however, when we turn to the pyramids of Egypt that all doubt is finally dispelled, and that we are thus enabled to turn to other structures which, considered by themselves, had seemed to give less satisfactory evidence, and accept in turn what these also teach.

I am not concerned that many Egyptologists deny the astronomical character of the pyramids, because on this point the opinion of Egyptologists is worth very little unless they happen to be also astronomers. No astronomer acquainted with the evidence can for a moment doubt that all the pyramids of Ghizeh were oriented astronomically, or that, at any rate, while this process was in progress—that is, while the building was being raised from base to mid-height—each pyramid was in fact an astronomical observatory. Of course, an astronomer may believe, if he likes, that though thus of necessity an observatory (even that it might be built of the desired shape and in the desired position) the Great Pyramid, or any of its fellows, was by no means an observatory for any other purpose. So any one observing that a telescope was mounted equatorially in so exact and perfect a way as to show that its own magnifying power must have been employed to secure the accuracy of its adjustment, might nevertheless assume, if he liked, that that was the sole end for which the telescope had been employed. The power which some men, even among astronomers, have for adopting unlikely explanations, where simpler ones are obviously suggested by the evidence, must be admitted, since it has been repeatedly manifested in surprising ways. It may be admitted as a conceivable, however unlikely, thought that men took an immense amount of trouble to make the Great Pyramid a perfect observatory for no other purpose than that they might square and orient the building as such a building would have had to be oriented in order that it might be a perfect observatory. As we can imagine no other purpose which the exact adjustment of the building in astronomical respects could possibly fulfil than that it should fulfil astronomical relations and be available for carrying out special astronomical work (of *some* sort), the theory that the exact adjustment was arranged only that the adjustment might be exact, and with no further end in view, will always delight a certain order of minds. But even so, we have at least this fact obvious to every astronomer, that the pyramids, and especially the Great Pyramid, must for a time have been astronomical observatories, even were it only that they might be built on the plan to which they unquestionably correspond.

So much is certain, let Lepsius and all other non-astronomical Egyptologists say what they will, leaving their own department to talk of what they do not understand. But let not us fall into their mistake, however, but accept their opinion unhesitatingly when they speak with one accord of what they do understand. It is as idle for the astronomer to deny that the pyramids are one and all tombs, as it is for the Egyptologist to deny their astronomical character. Of course, a paradoxical enthusiast may entertain the theory that an exception is to be made in the case of the great pyramid, and find even the sarcophagus in its interior to be no sarcophagus at all, but only a measure of capacity, stored where it could never be seen, and where, as a matter of fact, it was not understood until it was no longer in such a state that its capacity could be measured. It would be enough that the Egyptologist, here on his own ground, asserts this view to be utterly untenable, and that the Great Pyramid was unquestionably a tomb, to overthrow the theory absolutely, even if it were probable in itself; but in reality it is antecedently improbable, and is supported by no evidence of the least weight.

Finding, then, that the pyramids were certainly astronomical, and were as certainly tombs, we may infer with full confidence that they were temples especially intended for such ceremonial observances as belong to the worship of the heavenly bodies. For, on the one hand, astronomy meant in those days the worship of the host of heaven with astrological observances for the ceremonial of that Sabaistic religion; and, on the other hand, the tombs of the ancient Egyptians were as altars during the lifetime of their future tenants, and all the ideas connected with the entombment of the body were associated with religions. The pyramids were altars set in the midst of the vast temple whose roof is the star-lit sky; and within that temple the gods themselves, sun and moon and planets and stars, were ever present.

I would not be understood to assert here that all pyramidal structures were astronomical in plan and purpose. On the contrary, I recognise the justice of the opinion maintained by archæologists (and especially by students of Egyptian archæology), that pyramids were originally *mere* tombs. So were the mounds of which the pyramids in Egypt and the towers of Assyria were the developments. The astrono-

mical character of the pyramids of Ghizeh, of the Birs Nimroud, and of other ancient edifices, was probably a characteristic only given to tombs and temples at a later time, when the worship of the heavenly bodies had either replaced other forms of nature-worship, or had at any rate taken the chief position in the religion of the nation. We may indeed well believe that during one and the same era tombs and temples might be erected with astronomical significance and interest—some being raised for the special ceremonial belonging to star-worship, while others, being devoted to other forms than the heavenly orbs, had no astronomical characteristics. Thus may we explain, for instance, the obviously astronomical character of the Birs Nimroud, and the absence of any astronomical relations in others of the temple-tombs known as *Zikkaratus*, in Mesopotamia. Among the pyramids in Egypt and Mexico there are doubtless many which were not connected with the worship of sun or moon, the planets or the stars, but belonged to the worship of other powers, as those that were recognised in the wind and the storm, or in the earth beneath, or in the waters under the earth.

It is manifest, however, that during the rule of the dynasty to which the pyramids and tombs of Ghizeh belonged, all such powers of nature were for a time subordinated to the rule of the heavenly bodies. For, among all these structures, from the Great Pyramid down to the smallest of the stone tombs within the Ghizeh cemetery, the orientation is uniformly perfect. It would seem as though the workers in that place of tomb-temples had felt that now at least the true gods had been recognised, and that the full purpose of such structures as they planned would be attained if their work were purified from all reference save to the worship of the heavenly orbs: The sun, the manifest source of light and life; the moon, whose benignant but scarcely less potent influence they recognised, as month after month she came back in full splendour to their skies; the planets, whose devious wanderings they could not understand, but which they therefore felt to be all the apter emblems of mysterious, perhaps even Unknowable power; and the stars, whose unchanging configurations seemed equally apt emblems of eternal steadfastness.

What solemnity of meaning, what evidence of might and governance, must the heavenly bodies have possessed for those Egyptians of old times, that they should have constructed such altar-tombs as the Great Pyramid and its brother the second Pyramid, for the ceremonial observances by which the will of those orbs was to be read and their influence was to be propitiated! So soon as we recognise this meaning in the pyramids, beyond their intended use as tombs, we understand what before had seemed most mysterious in these structures. We can see that it was worth men's while to rear these immense masses of stone for the observation and worship of the gods of that age, even though each served only for that one person who was afterwards to occupy it as a tomb. Apart from that full belief in a future material life, a veritable resurrection of the body, for each tenant of that place of tombs, where the dynasty and their chief servants were buried, we see that, even during the lives of Cheops and Chephren, the fortunes of these kings were of such importance to the nation as to be worth insuring. And they might be insured, men believed, by such careful study of the movements of the heavenly bodies, such duly performed ceremonial observances in regard to them, as might avail, (1) to determine the precise influence exerted by each orb at each moment of either king's life, and (2) to indicate the time when the combined influences of all those heavenly beings were bestowed most favourably for the success of the undertakings, civil or military, of the ruling dynasty.

Here, verily, was the most impressive nature-worship the human race has yet known. The glory of the sun by day, the ever changing lustre of the swift-moving moon by night, the planets with their mysterious movements over the dome of the great sky-temple (adorned by multitudinous stars, which the fancy of men grouped into strange figurings of men and animals)—in all this men recognised the visible symbols of the unseen majesty of their deities. The movements which they traced, and in that sense knew, spoke to them of the unknown—nay, of what they deemed, and what therefore was for them, unknowable. Had they known what we know of the grandeur of the solar system, and of the still vaster glories of the star-strewn spaces around us, they might still have retained their belief that in the heavenly orbs they saw gods and goddesses, and in the interminable depths of star-strewn space the domain of the deities. But the interpretation of the movements of those orbs as Copernicus, Kepler, and Newton interpreted them would have been as fatal to their faith as it has been fatal to the doctrines—once reasonable, but now absurd—of judicial astrology. It was because those movements were seemingly inexplicable that they seemed divine. What was unknown and unknowable for them was what the unknowable ever has been for men—it was their heaven of heavens, the abode of those powers whose combined influence, ever-acting, all-potent, mysterious, represented for them what the idea of Deity represents for us.

Men could advance no farther in nature-worship than this. No race the world has ever known can do more, if it is to worship outward nature instead of nature's inner soul, than to take the heavens for the temple of the godhead, the heavenly bodies for the powers to be worshipped within that all-enclosing temple. Egyptians, Assyrians, Chinese, Persians, Indians, Mexicans—none among the nations rose beyond this. So soon as the thought—regarded as impious at first—entered the hearts of men, that the godhead is beyond even the mightiest, the vastest, and the most impressive of natural forces, the real unknowable took the place of that which had been but the symbol of the unknowable. The "power, not ourselves, making for righteousness" took the place of the natural powers men had heretofore worshipped. Nay, it may be said that the power which men began now to recognise was not only a power outside ourselves, but a power outside all that is, though including all that is—the glories of the heavens, the powers that rule in air and sea, in forest and river, in mountain and in valley, and in the ever-active regions beneath both land and water—the powers also that rule wherever there is life, and whose most marvellous and mysterious manifestations show themselves in the heart of man himself.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By Edward Clodd.

IX.—EXISTING LIFE-FORMS (*continued*).

B. *Animals.*

THE several types upon which all known animals are constructed are usually classed under the following six primary divisions, called sub-kingdoms:— (See next page.)

Tabular forms are convenient for clear presentment, but their hard-and-fast divisions are apt to be mistaken for real lines of separation, and in the foregoing list this caution is the more needful because the relations of the things set forth

Invertebrata	Protozoa (Gr. *Protos*, first; *zoon*, animal)	Simplest forms	*Ex.* Moneron, amœba, sponge
	Cœlenterata (Gr. *Koilos*, hollow; *enteron*, bowel)	Hollow-bodied	*Ex.* Polyp, anemone, coral-builder
	Echinodermata (Gr. *Echinos*, a hedgehog; *derma*, skin)	Spiny-bodied	*Ex.* Sea-urchin, starfish
	Annulosa (Lat. *Annulus*, a ring)	Joint-bodied	*Ex.* Worm, crab, spider, ant
	Mollusca (Lat. *Mollis*, soft)	Soft-bodied (but usually protected by a shell)	*Ex.* Sea-squirt, oyster, snail, cuttle-fish
	Vertebrata (Lat. *Vertebra*, a joint)	Back boned	*Ex.* Fish and all other higher life-forms to man

are intimate and indissoluble, the several sub-kingdoms merging one into the other like the colours of the rainbow. Moreover, any consecutive arrangement can only broadly indicate the relative order of the several life-forms, because development has not proceeded in direct line—*e.g.* the ant, which belongs to the Annulosa, is the highest of all invertebrates; but it is not, therefore, most nearly allied to the lowest vertebrate. The connecting link between these two great divisions, as will be shown presently, is found in the double-necked, bottle-shaped sea-squirt, or Ascidian (Gr. *askidion*, a little bottle), which is classed under the Mollusca, and for this reason that sub-kingdom is placed last but one in the ascending scale. If we go back far enough we find the common starting-point of all, whence they travelled for a while along the same road, and then diverged wider and wider apart, until it now seems difficult to believe that the lowest and highest of both plant and animal are one in community of origin.

I. PROTOZOA.—The lowest member of this group—in other words, the lowest known animal, if we except certain parasites, is the *moneron* (Gr. *monos*, single). Like the lowest plants, it lives in water, the element in which life had beginnings. It is an extremely minute, shapeless, colourless, slimy mass, alike all over, and therefore without any organs. When we say that it is alike all over, we mean that our range of vision does not enable us to report otherwise, for doubtless the simplest and smallest living thing is very complex in structure. And we mean, further, that there is no differentiation, as it is called—*i.e.* no formation of specific organs for the performance of specific functions. The functions of living things are threefold—nutrition, reproduction, and relation; in other words, to feed, to multiply, to respond to the outer world, and all these the organless moneron discharges. Every part of it does everything: it takes in food and oxygen anywhere, and digests and breathes all over its body. It literally "gets outside" its food, having the power of throwing out finger-like prolongations, called pseudopods, or false feet, with which it propels itself and spreads over its prey, sucking the soft body even from shelly creatures and casting away the refuse. So far as the function of nutrition, which includes digestion, circulation, and rejection of waste, and the function of reproduction, are concerned, the moneron performs these as completely as the highest animals. For these, with their complex sets of organs—lungs, heart, stomach, &c.—cannot do more than nourish themselves and keep the body in health. And in reproduction, which the moneron effects by dividing itself into two, as do the lowest plants, wherein, as in it, there is neither male nor female, it accomplishes in simple fashion what the higher life-forms can do only in a more complex way. So that the difference—which, however, is in degree and not in kind—between this slime-speck of protoplasm and the higher organisms, all made of like stuff, is in the discharge of the function of relation.

Reference has been made to the response to stimulus from external things manifested by the lowest life-forms although there is no trace of a nervous system in them, and now that we are treating of a living mass that not only feeds and digests and breathes all over, but likewise feels all over, a few remarks upon the origin of nerves may supersede the need for any detailed account of the several nervous systems in the representative animal types.

The function of the nerves is to bring the organism into relation with its surroundings; they are the special media of communication between the body and the external world, and between the brain and every movement of the parts of the body. Starting in the higher animals from the encased brain and ensheathed spinal cord, and diffused in the lower animals in less complex arrangement, they report from without to within. The vibrations of the ethereal medium that affect us as light enter the eye and pass along the optic nerve, which conveys the impulse to the brain, and it is the brain, not the eye, that sees. So with the air-vibrations that travel along the aural nerves; the sensation of sound resides in the brain, not in the ear; so with all the manifold sensations that we feel.

Therefore, wherever there is sensitiveness to impressions, however dim and feeble this may be, there the function of relation is being exercised. This sensitiveness is exhibited by the moneron in its shrinking when touched, and in its grip of food; but the sensitiveness is diffused, and not located in any organs. In members of the same sub-kingdom as it, there are faint traces of approach to nerve-structure, and the development of this is manifest in ascending scale till in the highest life-forms, among certain invertebrates and vertebrates, it reaches subtlest complexity.

Now as every part of a living thing is made up of cells, and the functions govern the form of the cells, the origin of nerves must be due to a modification in cell shape and arrangement, whereby certain tracts or fibres of communication between the body and its surroundings are originated.

But what excited this modification? The all-surrounding medium, without which no life had been, which determined its forms and limits, and touches it at every point with its throbs and vibrations. In the beginnings of a primitive layer or skin exhibited by creatures a stage above the moneron, unlikenesses would arise, and certain parts would by reason of their finer structure be the more readily stimulated by, and the more quickly responsive to, the ceaseless action of the surroundings, the result being that an extra sensitiveness along the lines of least resistance would be set up in those more delicate parts. These, developing, like all things else, by use, would become more and more the selected paths of the impulses, leading, as the molecular waves thrilled them, to structural changes or modification into nerve-cells and nerve-fibres of ever-increasing complexity as we ascend the scale of life. In brief, the stimulated film becomes modified into filaments; and the entire nervous system, with its connexions; brain and all the subtle mechanism with which it controls the body; organs of sense, with their mysterious selective power—the eye to receive light-vibrations, the ear to receive sound-vibrations, the nose to detect the fragrant and the foul; alike had their origin in infolded tracts of the primitive outer skin. The brain arose from such infoldings sinking down beneath the surface, and finally becoming imbedded in other tissues; the eye and the ear, as their parts developed, were joined from within by outgrowths from the brain. Such, in fewest words, is that theory of the origin of nerves which, formulated by Herbert Spencer, has been confirmed by all recent

biological research. And development by cell-modification applies to the body throughout, to bone, to cartilage, and sinew, as well as to the myriads of nerve-tissues, varying between the fifteen-hundredth and the twelve-thousandth of an inch in breadth, that keep us in touch with the universe. But, easy as it is to dissect and describe the nervous mechanism, the nature of the connexion alike between nervous impulse and consciousness in a man, and between sensation and contractile action in a moneron, remains an insoluble mystery.

What has been said concerning the diffused sensitiveness of the lower animals adds force and suggestiveness to Hæckel's remark, quoted in a former chapter, that the plant sealed its fate, limiting the action of the outer world upon it, when the protoplasm enclosed itself within a wall of cellulose. This isolation, or lessened susceptibility to the vibrations of air and ether, to changes of temperature, and a thousandfold subtle influences, the animal escaped by remaining mobile and setting up no barriers between itself and its environment.

A short step upward from the moneron brings us to the *Amœba* (Gr. *amoibe*, change), so called from its constant change of shape as it protrudes and withdraws the pseudopods. It shows approach towards unlikeness in parts, from the simple to the complex, in the modification of the protoplasm into a membranous skin at the surface, and in a nucleus near the centre, with an expanding and contracting cavity for distributing food and oxygen in the body—a primitive apparatus for digestion and circulation. Therein is the beginning of a division of function, of a distribution of labour, leading to cell-modification into organs. Some of the lowest amœbæ secrete, like the diatoms among plants, solid matter from the sea, building for themselves primitive organs of shelter and defence in the shape of exquisitely-formed chambered shells pierced with holes through which the soft body is connected and the pseudopods pushed for capture of food, which, as throughout the animal kingdom, consists of organised matter. Some form their skeletons of lime, others of flint, evidencing to the possession of a selective power or affinity by even the minutest creatures, and it is these skeletons of ancient foraminiferæ that compose vast beds of organically-derived strata.

Still more marked advance towards unlikeness in parts is shown in the *Infusoria*, so called because readily developed in infusions of exposed vegetable matter, wherein they crowd by myriads in the space of a water-drop. Instead of the pseudopods of the moneron and the amœba, we find vibrating filaments or cilia, by which supplies are swept into the body, which is furnished with an opening or rudimentary mouth and short gullet, through which the food and oxygen pass to the body-cavity. The protozoa which are free to move about can procure their food and oxygen easily, but such as are rooted to one spot have to develop special organs for securing these necessaries of life. These we find provided in the colonies of amœbæ known as *Sponges*, which, however, stand midway between the first and second sub-kingdoms, since division of labour is further developed in them, and traces of a nervous system are found among certain species. Very lovely are the skeletons which some of them secrete, such as Venus's flower-basket with its graceful fretted spirals; but more familiar to us are the useful fibrous and porous domestic sponges woven of material said to be chemically allied to that spun by silkworms. The amœbæ living on the outside of the sponge can procure food and oxygen easily; not so those living in the inside, and to effect this they have developed cilia, the whiplike action of which drives the water, charged with food and oxygen, through the innumerable canals, whence, having served its purpose, it is driven out, through other canals, carrying the refuse from the amœbæ with it. The whole sponge represents, as has been aptly said, a kind of submarine Venice, "where the people are ranged about the streets and roads in such a manner that each can easily appropriate his food from the water as it passes along."

II. Cœlenterata.—Speaking broadly, all the animals included in the first sub-kingdom are made up of single cells united together, but like one another; now we find the animals made up of many cells more or less modified into tissue, although still of low organisation, one evidence of which is that, like the protozoa, they have no vital parts, and that there is no separate canal for absorbing food and carrying away refuse, the mouth still opening direct into the body-cavity.

The lowest representatives of the "hollow-bodied" are the tiny cup or tube shaped, jellylike, green-hued polyps named *Hydra*, which, with their budlike clusters of young —soon to start in life on their own account—are found clinging, mouth downwards, to weeds and rubbish in fresh water. From the mouth hang a number of tentacles containing cells, in which lie barbed threads coiled up in a poison fluid. When anything touches these tentacles they contract, the cells burst and fling the threads, lassolike, around the prey, poisoning it with the fluid. From some of the marine species which secrete tubes of flint and project themselves therefrom like flowers, so that the sea-depths are covered with their waving, plantlike forms, the buds detach themselves, and become the beautifully tinted *Medusæ* or jelly-fish. These produce eggs which become rooted polyps, so that the offspring never resembles its parents, but always its grandparents. All living matter is largely made up of water, the average proportion ranging from seventy to ninety per cent., but in the jelly-fish it is about 400 to 1. Yet, fragile as is the creature, its structure is complex. Canals traverse the swimming-bell, and carry food and oxygen to every part; rudimentary muscles in the shape of contractile tissues propel the animal along, in rhythmic grace of motion; a nervous system runs round the margin of the bell; there are rudimentary eyes in beadlike pigment-spots, and rudimentary ears in small sacs also along the margin; and the hanging tentacles are charged, as in its fresh-water ally, with deadly fluid.

Lovelier still, and of slightly more complex structure, are the variously coloured *Sea Anemones*, with their petal-like tentacles; while nearly allied to these are the colonies of *Coral-builders*, which, despite the surging wave and drifting current, raise their treelike structures, foundations of solid land on which the bird will build her nest and man set his dwelling.

III. Echinodermata.—This division includes all rayed animals, the skin being hardened by the secretion of jointed or leathery plates, or of spines or hedgehog-like prickles. In some, as the *Starfish*, the rays spring from a common centre; in others, as the *Sea-urchin*, they are coiled to form a globular body; in the *Sea-lilies*, which abounded far back as Silurian times, but which are now rare, they spring, flowerlike, from the end of a fixed stalk; in the sluglike *Sea-cucumbers*, which possess the power dyspeptics may envy of throwing away the inside of the body and growing it anew, the skin is tough, the limy matter being secreted in scattered spicules.

All the echinoderms have the alimentary canal shut off from the body-cavity, involving special provision for nutrition. This is effected by a number of canals which communicate with the outside of the body, and through which the sea-water is driven by cilia, as in the sponges. The water is also pressed from the canals into numerous little suckers, by which the animal crawls along—nature's first

essay in land locomotion. There is a distinct nervous system, the fibres of which in the starfish run along each ray, at the tip of which is an eye, having about two hundred crystal lenses, and a primitive eyelid in the form of a filmy covering.

Thus far an intimate relation may be noted between the life forms of the invertebrates. The differences between the secretions of limy matter by the amœba and by the sea-urchin, between the contractile action of the moneron in every part and the localisation of nerve-function in the medusa and the starfish, between the vacuole of the amœba and the digestive canal of the sea-cucumber, are differences of degree and not of kind. They are one and all due to cell modification arising out of advance from the like to the unlike, from the simple and general to the complex and special, from the organless to the organised, and any addition to the bare details given above would only bring the more prominently into relief the fact of an indissoluble, underlying unity.

Note.—The word "certainly" on which Mr. Dawson animadverts was a slip of the pen omitted in proof, but overlooked in revise. My agreement with Mr. Dawson is shown in the note appended to table in the April number, p. 174, and which has probably escaped his eye; but my regret that the error in the March number was not referred to by me is lessened by the fact that it has called forth Mr. Dawson's interesting paper.

THE WELL OF ENGLISH UNDEFILED.

MR. HARRISON AND MR. FREEMAN.

MR. HARRISON has all the best of the argument with Mr. Freeman about the corruption of good old English into good old Saxon, and other forms of literary affectation. In fact, as to the general position maintained by Mr. Harrison there could be no two opinions among men whose common sense has not been overgrown and choked by pedantry. Not history alone, but literature generally, not even literature alone, but literature, art and science, are exposed to the affectations of those who are not satisfied to understand, but insist that they shall not be understood. Mr. Freeman is a type of a class—men who acquire a very full knowledge about a department of very moderate extent, and imagine themselves thenceforth supreme over that department, not only as dealt with by them but in all its relations with outside matters. Mr. Harrison compares his opponent with a brickmaker who should tumble a lot of bricks on the people's highway, and who, when remonstrated with by some one more careful of the people's rights, should say that the man who thus interfered with him was not a builder, knew nothing about bricks, nay, probably had never been in a brickfield in his life. It is a way all men have who too long and too rigidly confine themselves to one line of research. Mr. Harrison is quite right in insisting that it is wrong. As no private person has a right to hamper the people's highway, so no special student can be allowed to cumber our nation's language, the people's English, with words of his own making. Observe, we say "cumber"; "every builder in the Temple of Research" is free to leave "bricks of his own making" in the highway of the people's language occasionally and in moderation. But among pedants there is very little moderation.

In his reply to Mr. Freeman Mr. Harrison uses, as in his original remarks, the best possible weapon for his purpose—ridicule. Your pedant cannot bear ridicule. He cannot understand it. He has aimed to be Sir Oracle, and when some one sets all the dogs barking at him he is perplexed in the extreme. It is the best proof that there is no better implement for castigating his particular offence than well-directed ridicule. Sidney Smith once used a somewhat unsavoury comparison in regard to the use of ridicule in such cases. We shall not follow him in that, but his opinion was right in itself. There are offences which can only be effectively treated in one particular way, and when under that treatment the offenders squirm, we know that the right method has been employed.

Thus does Mr. Harrison put this point:—

"Mr. Freeman is much scandalised with me for beguiling the tedium of discussion with a jest or two; and he says my style of controversy is not that of 'a serious scholar.' I cannot undertake to be always in full academicals; and I think that, if an argument is sound, it is none the worse for being presented in a pleasant way. A great master told us it was best always to mix the *dulce* with the *utile*. I can remember how poor Robson used to preface his immortal 'Villikins' with the warning: '*This is not a comic song!*' but the warning was always lost on me. Why is it to be assumed that, if we are merry, we cannot be wise? I know that in this age of Teutonic *Gründlichkeit*, unless a man will school himself to be as dull as Professor Gneist, he is supposed not to have an ounce of Research in him. It used not to be so in the glorious eighteenth century. Hume and Gibbon, Diderot and Turgot, did not find learning incompatible with a lively manner or with good English and good French.

"The line which Mr. Freeman adopts is the one with which his readers are quite familiar. He behaves like a tutor correcting a pupil's exercise, and giving him what schoolboys call a 'ballaragging' for false concords and quantities. He cries out, 'Read what I have written in So-and-so! I suppose you think this? and, Why do you not read the other?' Every one knows that to cross Mr. Freeman in one of his linguistic fads is to risk being treated as my little boy was treated in the Zoological Gardens when he offered a bun to the porcupine. But I have had some experience with the *feræ naturæ*; and I have been conversant with the English language for a good many years. Of his work as an historian I have spoken with the great respect I unfeignedly feel; but in the matter of the best mode of writing our native tongue I cannot accept the authority of the most serious of scholars. Were I to put on my cap and gown, and had I the Professor before me to examine in the history of law, or of modern philosophy, or of the industrial movement, or the like, I should do my best to give him his '*Testamur*' politely, and I certainly should try not to look as if I were about to give him a caning."

Mr. Harrison very justifiably remarks further on Mr. Freeman's pedagogic style:—

"To employ such a tone to me is surely a little out of place. I have been occupied all my life, just as Mr. Freeman has, in learning, teaching, and studying; and, if my special periods or subjects are not quite the same as his, we are on fair terms in a question of general literature. Moreover, it so happens that, in my professional duty as professor of Constitutional History, these books which he tells me to go and look into are the ordinary text-books of my daily work."

The best of the fun is that after showing thus neatly how Mr. Freeman had forgotten himself, Mr. Harrison shows how, in quite another sense, Mr. Freeman has not remembered himself:—

"I mention a few points whereon he declares me to have blundered: but where the blunders are not mine, but his. Where, he asks, did I get the form *Knud*, for *Cnut?*

'*Knud*,' says Mr. Freeman, is 'quite beyond me.' Well! I got the form *Knud* from Mr. Freeman himself. In his 'Old English History,' edition of 1878, p. 222 (a little book expressly written for children), I read as follows:—'*Cnut* or *Knud* is his real name. He is often called *Canutus* or *Canute*. . . . It is better to call him by his own name.' Again, in the 'Norman Conquest,' vol. i. p. 442 (edition of 1867), I find as follows:—'*Cnut* or *Knud*, in one syllable, is this king's true name.' Having these passages under my eye, I wrote:—'*Cnut* or *Knud* . . . had rather a queer look.' I did not say that Mr. Freeman constantly used *Knud*. He tells children it is better to call the king by his own name, and that *Cnut* or *Knud* is his real name. And now he says *Knud* is quite beyond him; and that it would indeed look odd to talk about *Knud*. So I said."

"Then about Edward the Elder. Mr. Freeman reproves me for saying that Edward called himself *Rex Anglo-Saxonum*; that it ought to be *Rex Angul-Saxonum*. It so happens, that to be quite safe, I had before me, when I was writing this sentence, that admirable little book, 'Old English History,' by E. A. Freeman, p. 139 (edition of 1878), where I read that, 'He [*i.e.* Edward] commonly calls himself *Rex Anglo-Saxonum*' (*sic*). I simply copied out those words, as I was dealing with Mr. Freeman about a popular mode of speech. I was quite aware that the spelling of the Charters is *Rex Angul-Saxonum*, because, in writing, I had under my eye as well Mr. Green's 'Conquest of England,' pp. 192, 193, and Bishop Stubbs's 'History,' vol. i. p. 173, both of which so spell the title. But since the matter in hand was the name *Anglo-Saxon* itself, not the spelling of the name, I was satisfied to follow Mr. Freeman's *Rex Anglo-Saxonum*."

"Then, says Mr. Freeman to me, whence do I get my *Karl*, and where for twenty years past has he himself said anything about *Karl?* I did not assert that Mr. Freeman usually writes of *Charlemagne* as *Karl*. On the contrary, I wrote 'Professor Freeman taught us to speak of *Charles the Great*.' When, later on, I wrote—'we have all learned to speak by the card of *Karl*,' I had in my mind and under my eye a very famous essay, where I read the name *Karl* six times in twenty lines of print, all about the 'Legend of Charlemagne,' and the 'History of Karl.' My edition of this essay bears the date 1872. I cannot undertake to remember all the editions of all Mr. Freeman's books, or when he first dropped *Karl*. But having written that 'Professor Freeman taught us to speak of *Charles the Great*,' I felt amply justified by this essay in adding in a merry vein, 'we have all learned to speak by the card of *Karl*.' Professor Freeman's lessons are not so soon forgotten as he thinks."

This is as amusing as anything we have heard of in this line. But Mr. Harrison can see the serious aspect of the offence he thus ridicules. We commend to the very careful attention of our readers the remarks with which he draws his reply towards its close:—

"Names and words are current coin of the realm, which, for public convenience, have definite values; and to clip and deface them is to debase the linguistic currency. It is the part of a good citizen and a sensible man to carry on his transactions in the current coin, taking them and counting them at their official value. If a man, in order to make his words answer to facts, and not to raise any 'false ideas,' were to cut a five-shilling piece in two, and to offer the bits as two half crowns, the public would call him crazy, and the police would treat him as 'a smasher.' Mr. Freeman is really trying to pass amongst the lieges Saxon *sceats* and *scillings*, as if they were good current coin. The first magistrate before whom he is brought will tell him that *sceats* and *scillings* are not now in circulation, and that private persons have not the right of coining.

"Of course in this matter of spelling there are very real and important points behind. It is a serious evil to unsettle the language. It is unkind to throw fresh stumbling-blocks in the way of education. All singularity in forms, without motive or without adequate motive, is a fresh difficulty and a source of offence. If we tried to torture *all* names in history out of their current forms and into their contemporary orthography, if we tried with the modern alphabet to represent the various sounds of a hundred different languages, to spell the same name in a dozen different forms, according to the century of which we are speaking, this would produce a literary chaos. And since there is no adequate reason for specially selecting any one epoch or any one race for this equivocal distinction, it is the part of good sense and good English to be content with the current names long familiar to us in the best literature. These names, no doubt, do differ moderately, and from time to time, as language grows, changes in form are spontaneously adopted. But the claim of any scholar, however eminent, of any knot of scholars, to sweep the board of the familiar names for one particular epoch, and systematically to force on us and on our children another language in names—this is a bad claim, and ought to be resisted."

Extend what is here said chiefly of historical literature to literature generally, including the literature of art and science, and we have the true gospel in regard to the development of language. Technicalities have no more place in literature than medals have in current coinage.

COAL.

By W. Mattieu Williams.

THE SOURCES OF TERRESTRIAL CARBON.

THE engraving on p. 271 supplies an interesting illustration of the most characteristic of the coal-measure rocks. It is an engraving on wood, from a photograph of a piece I picked up on the spoil bank of a pit-sinking at Leeswood, in Flintshire. The extreme length of the specimen (measured on the face that is here represented) is $6\frac{1}{4}$ inches, and its thickness not quite $2\frac{1}{2}$ inches. It is the "Linstay" or "Linsey" rock I have already described, and it displays about thirty miniature seams of coal, with interlayers of sandstone. They do not come out so distinctly in the photograph as in the original on account of the shadows due to overhang; the middle dark band is made up of more than a dozen alternations.

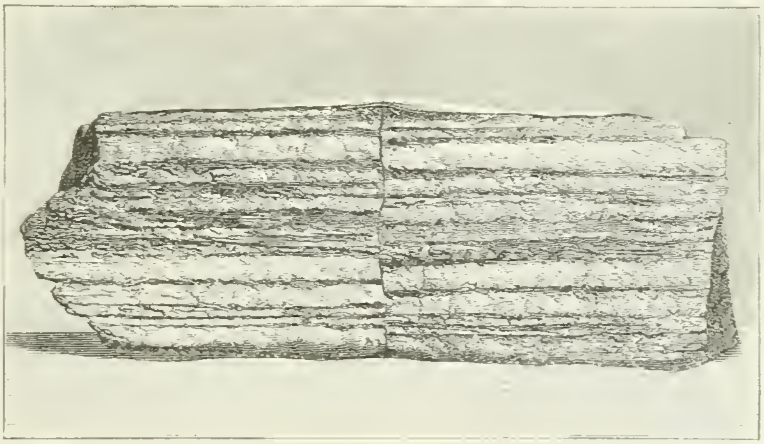
This specimen also presents a natural diagram in miniature of what so commonly occurs on a large scale in most coal beds—very vexatiously and frequently so in Flintshire. This is a fault. The working goes on smoothly enough along one of the seams indicated by the dark lines until it reaches the vertical dark line, which is a sort of crack running down through the strata. On crossing this the coal disappears, and the miner has to learn whether the fault is an upthrow or a downthrow, which he does by examination of the strata which is presented to him instead of coal. He knows by the record of strata (always carefully kept) through which he passed in sinking the pit what is above him, and if he comes upon a downthrow he may at once recognise his position, and estimate the measure of downthrow and consequent depth he has to sink in order to reach the coal again.

In the opposite case, when he meets an upthrow—*i.e.* when he has been working in a downthrow—he may or may

not have so definite a guide, according to whether or not other and deeper sinkings than his own have been made in the neighbourhood and the lower measures recorded in detail.

I may here note the origin of the geological technicality "coal measures." To anybody who, like myself, has had to pay the wages of sinkers (*i.e.* the men who sink the shaft), the etymology is very obvious, as the men receive a different rate of pay per yard, according to the character of the material through which they pass, whether "metal" or "rock," and the fortnightly pay is regulated by the character and amount of the *measures* of the work done; thus the strata themselves come to be described as "measures."

Some geologists have assumed that during the carboniferous period the atmosphere contained a larger proportion of carbonic acid than at present. This speculation is based on the fact that the carbon, which constitutes the bulk of plants, is obtained by them from the carbonic acid of the atmosphere by a process of dissociation in which the leaves or other green parts of the plant employ the solar radiations to separate the carbon from the oxygen with which it is combined in the carbonic acid. This theory is not so well received now as when I attended Professor Jamieson's class in Edinburgh, but the problem which it struggled to solve



still remains. It is one of great magnitude, and though commonly evaded, is so fundamental that until it is solved we must confess ourselves profoundly ignorant of the barest rudiments of geological philosophy.

To understand the magnitude of this problem a few figures are necessary. In the first place, the quantity of carbonic acid at present existing in the earth's atmosphere, as determined by the most careful analysis, is between 0·04 and 0·05 per cent. by volume, or $\frac{1}{1333}$ part by weight *over the land.* Over the sea it is much less, the mean of the whole earth falling short of $\frac{1}{2000}$ part by weight. The mean pressure of the whole atmosphere is, in round numbers, 2,000 lbs. per square foot, and thus we arrive at 1 lb. as the total quantity of carbonic acid over every square foot of the earth's surface. 1 lb. of carbonic acid (carbonic dioxide) contains but $\frac{6}{22}$ of carbon, in round numbers $4\frac{1}{2}$ ounces, or the quantity contained in $5\frac{1}{2}$ ounces of ordinary coal. Therefore all the carbonic acid now existing in our atmosphere is only capable of producing a film of coal covering the earth, and weighing $5\frac{1}{2}$ ounces to the square foot. A cubic foot of ordinary coal weighs from 80 to 85 lbs.; therefore the stratum of coal obtainable by using up the whole of the carbonic acid in the earth's atmosphere would be not quite $\frac{1}{240}$ of a foot, or less than $\frac{1}{20}$ of an inch in thickness.

Mr. J. L. Mott, in a communication to the British Association, 1877, concludes, as the result of careful calculations, that the average amount of unoxidised carbon deposit in the crust of the earth amounts to three millions of tons per square mile; this would be represented by four millions of tons of coal, or, in round numbers, 3 cwt. to the square foot. This is 1,000 times more than all the carbonic acid now existing in our atmosphere is capable of producing. If the atmosphere had at any period of the world's history contained $\frac{1}{100}$ of this amount, animal life, such as indicated by animal fossils, would be certainly impossible. Therefore some great reservoir of carbonic acid is demanded, far exceeding that ever contained in any breathable atmosphere. Besides this, for every 6 lbs. of carbon separated from the carbonic acid 16 lbs. of oxygen must be evolved.

It is customary to pass over this difficulty rather lightly, as Lyell does when he says that "we may imagine time to have multiplied the quantity of carbon given out annually by mineral springs, volcanic craters, and other sources, until the component elements of any given number of coal seams have been evolved from below, without any variation in the meantime in the constitution of the atmosphere."

The contribution of volcanoes to the carbonic acid of the atmosphere is effected chiefly by the decomposition of limestone and magnesian rocks—carbonates of lime and magnesia. Pliny the elder was suffocated by the carbonic acid from Vesuvius. If these are made to give off their carbonic acid by simple heating, as in a limekiln, they practically contribute no carbonic acid, as the alkali left behind is greedy for carbonic acid, and sooner or later finds it in air or water; but when the carbonates are heated sufficiently in contact with silicious rocks, the silicic acid combines with the lime or magnesia, taking the place of the carbonic acid, which is released as gas.

Those who describe this as a sufficient source of supply of carbonic acid usually (or always, so far as I can learn) take no account of, and apparently do not understand, another action which is exactly the opposite, an action in which the carbonic acid of the air is absorbed and releases silicic acid. This is more potent than the volcanic opposite, though less striking, as it goes on steadily and continuously—has been going on from the earliest geological periods. It is called *kaolinisation*, or the conversion of the silicates of potash and soda contained in the primary crystalline rocks into kaolin, *i.e.* the clays that have been formed from their disintegrated and decomposed materials.

Dr. Sterry Hunt has carefully calculated the amount of carbonic acid required for the production of a stratum of 500 mètres (1,640 feet) of kaolin or clay, or clay-rock, over

the whole surface of the globe, and finds that, if produced by the kaolinisation of orthoclase, it must have used up a quantity of carbonic acid equal to twenty-one times the entire weight of our atmosphere, *i.e.* $2000 \times 21 = 42000$ times as much carbonic acid as the air now contains. The demand for this gas in the decay of such silicates as hornblende, pyroxene, and olivine is five times as great; therefore such a stratum produced from these would have used up 210,000 times as much carbonic acid as our atmosphere now contains.

But this is not all, nor nearly all. If the earth were ever in the heated condition usually supposed, no such carbonates as our magnesian and limestone rocks, nor other earthy carbonates from which they might be formed, could have existed; the lime, the magnesia, &c., must either have been in the caustic condition or combined with silica, most probably the latter.

The demonstrable chemical conditions necessary for the existence of such carbonates force upon us one of two alternatives. We must either abandon altogether the theory of a highly heated globe that has cooled down, or regard all the carbonic acid existing in our limestones, &c., as of atmospheric origin—as a constituent which they have obtained from the atmosphere subsequent to their cooling down.

The carbonates in the earth's crust have been estimated as equivalent "to a continuous layer of limestone 869 mètres (2,851 feet) thick, and probably to more than double this amount." (Sterry Hunt.) According to this the earth contains in this form an amount of carbonic acid equal in weight to 100, if not to 200 atmospheres like the present, or 200,000 to 400,000 times the amount of carbonic acid now existing in the atmosphere.

Adding all these quantities together, we reach an amount of carbonic acid of atmospheric origin which utterly confounds all the prevailing notions concerning the past history of our globe in its relations to its atmosphere. Dr. Thomas Sterry Hunt, who is a philosophical chemist and geologist, one who is not satisfied with merely repeating the lessons he has learned at college and adding to them the mechanical results of laboratory and field work, has treated this subject with his customary vigour and originality in a paper communicated to the *American Journal of Science*, vol. xix., May 1880, on "The Chemical and Geological Relations of the Atmosphere;" also in another paper in the same journal, vol. xxiii., February 1882, on "Celestial Chemistry from the time of Newton;" and in the preface to his volume of "Chemical and Geological Essays," published by the Naturalist's Agency of Salem. I strongly recommend the study of these papers to all who are interested in this subject. A summary of them will be found in the abstract of a memoir presented by their author to the British Association at Dublin, 1878, which is printed in their "Proceedings," and also in *Nature* for August 29, 1878.

The solution which he offers is the following, quoted from p. 356 of the *American Journal of Science*, May 1880:—"The problem still before us is, then, to find the source of the vast amount of carbonic dioxide continuously supplied to the atmosphere throughout the geologic ages, and as continuously removed therefrom, and fixed in the form of carbonaceous matters and limestones. We have shown reasons for rejecting the theory which would derive the supply either from the earth's interior or from its own primal atmosphere, and must therefore look for it to an extra-terrestrial source. The new hypothesis, which we here advance, starts with the assumption that our atmosphere is not primarily terrestrial but cosmical, and that the air, together with the water surrounding our earth (whether in a liquid or a vaporous state), belongs to a continuous elastic medium, which, extending through the interstellar spaces, is condensed around attracting bodies in amounts proportional to their mass and temperature. This universal atmosphere (if the expression may be permitted) would then exist in its most attenuated form in the regions farthest distant from these centres of attraction; while any change in the gaseous envelope of any globe, whether by the absorption or condensation, or by the disengagement of any gas or vapour would, by the laws of diffusion and static equilibrium, be felt everywhere throughout the universe."

Those who have read my essay on "The Fuel of the Sun" (January 1870) know that I arrived by a different path to the same conclusion as Dr. Hunt concerning the universal diffusion of atmospheric matter. I regard such diffusion into all space which is receiving radiant heat as a necessary and demonstrable operation of the firmly established laws of gaseous diffusion.

The revelations of the spectroscope suggest a further development of this hypothesis. The characteristic feature of the spectrum of comets is the pair of bright lines a little way beyond H in the ultra-violet region, which correspond to those obtained artificially from hydrocarbons, such as olefiant gas, &c. Similar lines have been observed in the trail of meteors that have penetrated our atmosphere. The researches of Schiaparelli and others have shown an intimate connection between these meteors and comets.

In the *Gentleman's Magazine* of August 1881 I ventured to put these facts together, and to suggest that "comets and fiery meteors, instead of being the weapons of divine vengeance, wielded for the destruction of the world, have been beneficent contributors of the chief material of its animal and vegetable life"—my supposition being that there is diffused through the usually assumed vacuity of space (or at least in that portion through which our solar system travels) considerable quantities of matter having the nature of volatile hydrocarbons, such as paraffin, naphthalin, benzole, &c.—most probably paraffin—which exist, according to temperature, either as solid, liquid, or gas; and which, striking our atmosphere in the form of solid particles, are heated and burnt by the collision, thereby producing both water and carbonic acid, which would thus be gradually and perpetually introduced.

At the Southampton meeting of the British Association (1882) Captain Abney read a paper, in which he stated that he had found benzine and ethyl "indicated in the spectrum at sea level, and found their absorption lines with undiminished intensity at 8,500 feet. Thus, without doubt, hydrocarbons must exist between our atmosphere and the sun, and it may be in space." (*Nature*, October 12, 1882, p. 586.)

GALILEO, DARWIN, AND THE POPE

By Richard A. Proctor.

BETWEEN Mr. Mivart, a Catholic believer in the evolution of man from lower forms of animal life, and the Rev. J. Murphy, Catholic theologian, a controversy has arisen which well deserves to be noted, because it serves to indicate the precise attitude of the Catholic Church towards the doctrine of evolution and science generally.

On the one hand, Mr. Mivart has maintained that he, as a Catholic, is free to teach that man, so far as his body is concerned, has been developed from lower types of life. On the other, Mr. Murphy asserts, as do most Catholic theologians, that this doctrine is heretical, and cannot be maintained by any loyal Catholic. Mr. Mivart retorts that the

teaching of the Catholic Church on such matters is not authoritative, and cites the case of Galileo to show that when the Pope has dealt with scientific matters he has not been infallible, wherefore "men of science should in no wise allow their efforts after truth to be checked by ecclesiastical declarations." To which Mr. Murphy makes rejoinder that the case of Galileo is quite unlike the case of Darwin, and, moreover, that the Pope never did pronounce on Galileo's teachings after the manner which is essential for all decisions to which the Catholic Church attributes infallibility.

Now, it may perhaps be asked by a large proportion of my readers what possible interest this particular controversy can have for those who neither hold Mr. Mivart's somewhat artificial theory nor take any interest in questions of Catholic theology. In reality, however, a much wider question is seen to be at issue, so soon as the nature of the doctrine of Papal infallibility is understood. So few non-Catholics know what this doctrine is, and so many Catholics misunderstand it (Mr. Mivart manifestly does) that a few remarks on this point (where Mr. Murphy has all the best of the argument) may be necessary.

I premise that, though I am neither a theologian nor a Catholic, I have given more attention to this special matter than most non-theological persons. Nay, many who are by way of being theologians have not had the opportunities I have had, and have availed myself of in large degree, for learning how the matter really stands. I most carefully studied this particular question as dealt with by that pillar of orthodoxy, that champion of convocation, the late Dr. Jelf, Principal of King's College, London, and so far to his satisfaction, at least, that he sent for me to receive his special congratulations on my treatment of the matter. It was almost the last of all the subjects I studied when preparing to join the ministry of the Established Church. It was a subject which I specially studied and ("which is else") *weighed*, during more than eight years, as taught by Catholic theologians. And finally, the associated minor subject, the special doctrine which Mr. Mivart is able to hold while still remaining in the bosom of the Catholic Church, chances to be one which has been again and again described to me by Catholic theologians as unquestionably heretical, and not to be held by any loyal Catholic, their remarks being very specially and personally pertinent. I doubt if any man living, not excepting Mr. Mivart himself, has had so much occasion to consider this special point as I have. This will be understood when I note that there was a time in my life when Mr. Mivart and I stood side by side, he as a student and teacher of biology, I as a student and teacher of astronomy, each, however, with this matter of the evolution of man as a factor in determining his course. He went one way, or rather continued on his course unchanged; I went another. His controversy with Mr. Murphy shows me that had he had the same theological training I had had as to the general principles of Catholic orthodoxy, he could hardly have continued on his course—to one side or to the other he *must* have diverged; to follow the middle course would have seemed to him, as it did to me, no less impossible than—

—to o'er walk a current* roaring loud,
On the unstable footing of a spear.

Mr. Murphy is assuredly right in his interpretation of Papal infallibility—in fact there can be, or at least ought to be, no possible mistake on this point. In my opinion, and, so far as I can judge, in the opinion of nearly all Catholic priests, Mr. Murphy is also right in asserting that Mr. Mivart's doctrine of the evolution of man is emphatically heretical.

Papal infallibility, which many fondly imagine to be the weak point of Catholicity, is, rightly understood, its strongest support. The Catholic Church may for ages have been unwilling to emphasize this doctrine by a decree of council; and in this she may have been wise in her generation; for, however strong the doctrine may be in regard to Catholicity, it is unquestionably a weakness in regard to Christianity. It needs no defence against Protestantism, but it needs to be very shrewdly defended against freedom of research if the defence is to be maintained at all.

The doctrine as commonly misunderstood, is, of course, preposterous on the face of it. But the common mistakes about the doctrine are themselves preposterous. One hears an ignorant but most zealous Protestant talk such nonsense as this: How *can* the Pope be infallible when such and such a Pope was notoriously unwise, and such another a man of evil life? It would be just as reasonable to say, How can we believe David to have been inspired when we find that he behaved not only villainously but most foolishly in regard to Uriah the Hittite and his wife? Not quite so absurd, though quite as incorrect, is the idea that Papal infallibility is disproved by the decision (supposing for the moment it received Papal sanction) against Galileo; it is fairly matched by the mistake of supposing that a reasonable doctrine as to Bible inspiration would be shaken by the mistake of Matthew in asserting that all the kingdoms of the earth could be seen from some exceeding high mountain.

The fact really is that the doctrine of Papal infallibility as it is really taught by the Catholic Church is almost a corollary on the doctrine of Bible inspiration. According to the latter doctrine, in its only reasonable form, men like Moses, David, Solomon, Ezra, Isaiah, and the like, in no sense to be regarded as perfect either in wisdom or in conduct, were inspired as respects certain matters which they addressed to men in regard to religion. The former doctrine, in the only form ever adopted by the Catholic Church, asserts that Popes, though in no sense to be regarded as perfect either in wisdom or in conduct, have always been and always will be so far guided or restrained (as the case may be) that *if*, or *when*, they address the whole Church *ex cathedrâ* on matters relating to morals or doctrine their teaching will be true. In conduct a Pope may be imperfect or even wicked; in regard to science, art, or literature he may be ignorant or unwise; in theological matters, even dealt with as by a priest or doctor of the Church, a Pope may make serious mistakes; *but* no Pope, let his personal qualities be what they may (let him even be overbearing as Moses, as unscrupulous as David, as selfish as Solomon, as ignorant as Matthew, or as contentious as Paul), will ever address to the whole Church *ex cathedrâ* false teaching as to morals or as to doctrine. Those who have swallowed so large a camel as the belief that Moses could teach nought unjust, David nothing evil, Solomon nothing loose, Matthew nothing unsound, and Paul nothing false in reasoning, need hardly scoff at those who decline to strain out so small a gnat as the doctrine that a Pope will be prevented from doing, what indeed a Pope would scarcely have a chance of doing—addressing questionable teaching, *ex cathedrâ*, to the whole Church about matters which Catholic theologians have long since settled in nearly every detail.

Be this as it may, the Catholic doctrine on the subject is perfectly definite; and it is absolutely certain that the decision in regard to Galileo's teaching, shown now to have been unsound, does not in the slightest degree affect the doctrine of the infallibility either of the Pope or of the Church.

* The printers are earnestly requested *not* to insert a comma after "current," as in most editions of Shakespeare, since Shakespeare assuredly did not mean that the o'er-walker was loudly roaring, but the current.

The subject-matter belonged neither to morals nor to faith; the decision was neither *ex cathedrâ* nor addressed to the whole Church; in not one single point does the case illustrate the doctrine of Papal infallibility as defined by the Vatican Council, which pronounced that—

The Roman Pontiff, when he speaks *ex cathedrâ*, that is, when in the discharge of his office as pastor and teacher of all Christians, he, in virtue of his supreme apostolic authority, defines a doctrine of faith or morals to be held by the universal Church, is, by the Divine assistance promised to him in the blessed Peter, endowed with that infallibility wherewith our Divine Redeemer willed that His Church should be endowed in defining doctrines of faith or morals.

Every Catholic, then, is free to believe that the earth goes round the sun. Nor is there anything in the doctrine of astronomical evolution which need trouble the Catholic, however fatal every such doctrine may be for the believer in an unreasonable doctrine of verbal inspiration. The Catholic may hold what the Protestant cannot loyally believe, that when the writer of the first books of the Old Testament, whoever he may have been, dealt with the sun, the moon, and the stars, there was no absolute necessity, since he was not writing about matters concerning morals or faith, that he should be saved from error.

But, as Mr. Murphy correctly points out, Mr. Mivart is quite mistaken in supposing that the real heterodoxy of a Darwin can be shielded by any evidence as to Church mistakes about the supposed heterodoxy of a Galileo. The Copernican theory manifestly has no connection with the fall and redemption of man; the Darwinian theory as manifestly has a very direct bearing on that special business of the Church. It needs no conclave of cardinals, no utterance of the Pope, *ex cathedrâ* or otherwise, to show that the doctrine of the descent of man from lower animal types, and the necessarily associated doctrine of the origin of evil, are irreconcilable with the teaching of the Catholic Church in regard to the fall of man from a state of original rectitude. Such an attempt as Mr. Mivart's to dissociate the origin of man's spiritual nature from the development of his corporeal nature is manifestly mere playing with the question. An individual person, here or there, may be able honestly (let us hope) to say, "I believe my body came from ancestors of anthropoidal apelike nature, but my moral nature descends from something originally breathed into an ancestral pair anthropoidally apelike in nature." Church creeds, however, are not for individual persons of exceptionally ingenious turns of mind, but for the masses. Assuredly the Catholic Church is not likely to adopt Mr. Mivart's ingenious but very artificial theory. Nor does she even now hesitate to say, whenever the question is directly put to her, that the doctrine is clearly and manifestly heretical.

I view the matter, let me remark in conclusion, from an entirely independent standpoint. I stand neither beside Mr. Mivart nor Mr. Murphy. But from where I am I can see that, while Mr. Murphy stands on perfectly firm and level ground—I say nothing as to its elevation—Mr. Mivart stands, if he stands at all, in a most insecure position. The bough to which he clings, the vain hope that, because the decision of certain Catholic disciplinarians in regard to Galileo proved erroneous, it may still be found possible to reconcile loyalty to the Catholic Church with belief in the theory of biological evolution, or that a fanciful distinction between his views and Darwin's will save him from condemnation, is rotten to the core. In one way or the other he *must* move: he may climb to securer heights, or he may wait till the frail bough breaks and he falls; but stay where he does he cannot, unless, closing his eyes, he sinks his feet very deeply in the morass which he has mistaken for stable ground. Resting *there*, however, will be no salvation.

INDIAN MYTHS.

By "STELLA OCCIDENS."

Behold it!
See the sacred Star of Evening,
You shall hear a tale of wonder,
Hear the story of Osseo,
Son of the Evening Star, Osseo!

LONGFELLOW.

TO the imaginative mind of the Indian the starry heavens were suggestive of many quaint and beautiful myths. As he saw the stars, night after night, and wondered at their brilliancy, he wove a halo of romance and superstition around them. Here were supposed to dwell beautiful spirits, or the souls of departed warriors and heroes; and intimately connected with these spirits were the fairies and pigmies, supposed to inhabit the earth. Thus we find that the belief in fairies, gnomes, pigmies, elves, and giants, exists in the folklore of the Indian, resembling that of the European nations. Leland * tells us in his tales of magic that "to every Algonquin a rotten log by the road, covered with moss, suggests the wild legend of the log-demon. The Indian corn and sweet-flag in the swamp are the descendants of beautiful spirits, who still live in them. Meeko, the squirrel, has the power of becoming a giant monster; flowers, beasts, trees, have all loved, and talked, and sung, and can even now do so, should the magician only come to break the spell."

An Algonquin myth is related concerning Osseo, son of the Evening Star, which is full of poetical feeling. An Indian hunter who lived in the north had ten beautiful daughters. All were married but Oweenee, the youngest and fairest. She scornfully rejected all her suitors, but at last accepted Osseo:—

Old Osseo, poor and ugly,
Broken with age and weak with coughing,
Always coughing like a squirrel,
Ah, but beautiful within him
Was the spirit of Osseo,
From the Evening Star descended,
Star of Evening, Star of Women,
Star of tenderness and passion!

Oweenee's sisters sneered at her choice, but she did not notice them. One evening they were all invited to a feast in honour of the Evening Star, and as they walked along together in the twilight they laughed at Osseo. He would look up at the stars and mutter to himself; and one of the sisters hoped he would stumble and break his neck, so that Oweenee might then have a handsome husband. Osseo was looking at the Evening Star, and addressing his father who dwelt there. As he approached a large wooden log, he suddenly stopped, and uttering a peculiar yell he dashed in at one end and came out of the other—a beautiful youth. He ran on nimbly and joined the rest, but looking for Oweenee he saw in her place an old, wrinkled woman, bent double with age and leaning on a cane. All the sisters laughed at Oweenee, but Osseo was kind and gentle to her. He walked beside her with slower steps, called her Nenemoosha, which means sweetheart, and soothed her with loving words till they reached his father's lodge.

During the feast all were happy but Osseo, who was sad and refused to eat. He would look at Oweenee and then at the Evening Star, which glimmered faintly in the sky. Presently he heard a voice, which sounded like strains of distant music to the rest. It told him to eat, as the food was enchanted and would make him a spirit. All his bowls

* "Algonquin Legends," p. 339.

and kettles should be turned to wampum and silver, and the women should be changed to birds, "and glisten with the beauty of the starlight." "Come, my son," it said, "and dwell no longer on earth. Look steadfastly at my beams; my power is now great. Doubt not, delay not. It is the voice of the spirit of the stars that calls you away to happiness and celestial rest."

Soon the lodge began to shake and tremble, and in a moment it was rising in the air. Before the sisters had time to escape the lodge was above the tops of the highest trees. The bowls and kettles became scarlet shells, the poles of the lodge were now glittering silver wires, and the bark covering them was changed to the gorgeous wings of insects. The sisters were all changed into birds of various plumage, but Oweenee, who still remained old and ugly. Osseo uttered a peculiar yell, and Oweenee became young and beautiful again. When the party reached the Evening Star Osseo's father bade Osseo hang up the cage at the door. He told Osseo that he had shown pity to him on account of his wife's sisters, who had ridiculed him whilst under the power of the wicked spirit. "That evil spirit is Wabeno, the magician, and he dwells in that little star that twinkles yonder. Beware of him, lest his beams fall on you."

Osseo dwelt for many years in peace and quiet with his father, and Oweenee bore him a son, who was as beautiful as his mother and courageous as his father. As the boy grew older the father made him little bows and arrows. Opening the silver cage, he let loose the uncles and aunts for his little son to shoot at. One day the boy shot a bird with his fatal arrow, and, behold! a beautiful maiden stood before him with the arrow in her breast. As the blood fell on the planet the charm was broken: Osseo's son, all the birds, Osseo, and Oweenee felt themselves descending, till they rested on an island in the Big-Sea-Water.

The birds became mortals again, but were transformed into fairies.*

> They remained as little people,
> Like the pigmies, the Puk-Wudjies,
> And on pleasant nights of summer,
> When the Evening Star was shining,
> Hand-in-hand they danced together
> On the island's craggy headlands,
> On the sand beach, low and level.
> Still their glittering lodge is seen there
> On the tranquil summer evenings,
> And upon the shore the fisher
> Sometimes hears their happy voices,
> Sees them dancing in the starlight.†

Now we must hear the story of one of these Puk-Wudjies, or vanishing little men, in connexion with the Morning Star. The Odjibwas have a myth concerning the time when "all the inhabitants of the earth had died excepting two helpless children, a baby boy and girl. The girl developed rapidly, but the boy remained a dwarf, and his sister called him He-of-the-Little-Shell. She made little bows and arrows for him, and in time he became a great hunter. One day he came to a small lake, and saw a man on the ice killing beavers. He-of-the-Little-Shell slipped out of his hiding-place, and wielding his magic shell, cut off the tail of one of the beavers. The man was surprised, on reaching home, to find the tail of one of his beavers gone, and the same occurrence happening every day, he became suspicious. One day he went earlier than usual, and returned home before He-of-the-Little-Shell reached the lake. The latter followed the stranger to his lodge, and let the man, who was no less than Manabozho, see him.

* Schoolcraft, "Hiawatha Legends," p. 71.
† Longfellow, "Hiawatha."

"Who are you, little man?" said Manabozho. "I have a mind to kill you."

"If you were to try to kill me, you could not do it," said the little man.

When he went home he told his sister they must part, as Manabozho would try to destroy them. He asked his sister where she would like to go.

"I would like to go to the place of the breaking of daylight. I have always loved the East. After I get there, my brother, whenever you see the clouds in that direction of various colours you may think that your sister is painting her face."

"And I," said he, "shall live on the mountains and rocks. And I shall ever be called Puk-Wudj-Ininee, or the wild man of the mountains."

He then told his sister that he must go in search of some Manitoes, and after many adventures he returned to her.

"My sister, there is a Manito at each of the four corners of the earth,"* he said. "There is also one in the sky, and a wicked one deep down in the earth. We must now separate. When the winds blow from the four corners of the earth you must then go. They will carry you to the place you wish. I go to the rocks and mountains, where my kindred will ever delight to dwell."

Taking his ball-stick he ran up a high mountain, whooping as he went. The winds blew, and his sister was borne to the eastern sky, where she has been ever since, and her name is Morning Star.†

> Blow, winds, blow! my sister lingers
> For her dwelling in the sky,
> Where the morn, with rosy fingers,
> Shall her cheeks with vermeil dye.
>
> There my earliest views directed
> Shall from her their colour take,
> And her smiles, through clouds reflected,
> Guide me on, by wood or lake.
>
> While I range the highest mountains,
> Sport in valleys green and low,
> Or beside our Indian fountains
> Raise my tiny hip hollo.‡

AMERICANISMS.

(Alphabetically arranged.)

By Richard A. Proctor.

Do Tell! One of the oddest of the regular Down-East sayings. It does not in the slightest degree signify what it says. In fact it means more nearly "don't tell" than "do tell," being used precisely as country folk in England say, "You don't tell me so!" "You don't say!" and so forth. An equivalent Yankeeism for "Do tell!" or "Dew tell!" is "I *want* to know."

Dough-face. A nickname applied by Northern abolitionists to Northern favourers of slavery.

Dough-nut. A small round cake, made of flour, eggs, and sugar, moistened with milk and fried (Bartlett says "boiled," which seems absurd) in lard.

Dove. In many parts of America "dove" is used as the past of "dive."

Down Easter. Used throughout the States generally for

* The Indians believe that the earth is a square and level plain, and that the winds blow from the four corners.
† Schoolcraft, "Hiawatha Legends," p. 90.
‡ Ibid. p. 94. These lines are supposed to be addressed to the winds by Wa-Dais-Ais-Imid, or He-of-the-Little-Shell, on transferring his sister to a position as one of the planets in the morning sky.

Yankee or New Englander. But as we approach the Down-East region, the Down Easter retreats, until we find his true place to be in Maine. Possibly in Maine he is pushed farther east still.

[*Drat it.* Bartlett treats this expression as an Americanism. While fully admitting that many expressions, often used in England, are properly classed as Americanisms, if much oftener heard on the other side of the Atlantic, I must draw the line at "Drat it," for there is no part of England, scarcely a house in England, where this singularly elegant expression of feminine wrath is not occasionally heard.]

Draw a Bead, To. To take aim. Probably old English also.

Dreadful. Used for "very," is probably more common in America than in England. "A *dreadful*, or *dreffle* nice gall," is a very nice girl. A dreadful odd way of speaking this.

Drummer. A commercial traveller. Probably derived from the good old times in England, when cheap-jacks and mountebanks announced their entrance into a town with sound of drum.

Dubersome. Doubtful. Bartlett says *duberous* is often used in England. I should imagine it was much oftener used in America. I have never heard of any part of England where "duberous" is used; and I have heard it pretty often in America.

Dug-out. A boat or canoe, dug out of a large log.

Dump. To unload from a cart by tilting is surely as much English as it is American; and *Dumpy*, for sad, is about as old English as well can be. It must have been in use long before the ballad of Chevy Chase, where the gallant Witherington, in most doleful dumps, when both his legs were cut away, did fight upon his stumps.

Dunno'z I know. Lowell gives this as the nearest approach a Yankee ever makes to saying, "I don't know."

Dust. To get out, clear, may be an Americanism; but imagine finding.

[*Duster*, a light garment, used for protection against dust, so classified! We wonder how many Derby days ago the "duster" first made its appearance on Epsom Downs.]

[*Dutch.* "That beats the Dutch," again is given by Bartlett as an Americanism, first used during the siege of Boston in 1775. It belongs in reality to Old England, time of Charles II.]

Dutch, for German, is, however, essentially American.

Eagle. A gold coin, worth ten dollars. *Double eagle*, *half eagle*, and *quarter eagle* need no explanation.

East. "About east" is used in New England for "about right," or what 'Arry in England would call *terrights*.

Eat. To supply with food. "To *eat* guests" means to board them, just as in England people say to "bed," meaning to find a bed for a guest. Sometimes a host may eat his guests in another sense. At a hotel where I once stayed, I found a finely-coloured motto rather unfortunately spelt: it ran "Watch and prey." Its owner carried out the idea.

E'en a' most, an abridgment of "Even almost" is called by Bartlett a vulgarism. It would be well if there were no worse vulgarisms in America or England than this.

"*Eend.*" Yankee for "end." "Who'd expect to see a tatur all on eend at being biled?"—*Lowell*.

[*Egg on, To.* Corruption of "to urge on." See *Drat it.*]

Egypt. Southern Illinois. Bartlett "wants to know" whether this is on account of its fertility or the mental darkness of its inhabitants. I should imagine that any one who had seen the region around Cairo in the good old times (remember that Cairo was the Eden of "Martin Chuzzlewit") would need no explanation. Probably Cairo was so called because the region around Cairo in Egypt after an inundation of the Nile looked about as forbidding as the region around Cairo in Illinois looked all the time.

Elect, To. To choose to do something or other. The American "elects" a president or member of Congress just as the Englishman "elects" a member of Parliament or a churchwarden; but, unlike the Englishman, the American "elects" to do as he pleases about voting.

Elephant. To "see the elephant" is to travel about and see the world.

Elevator. What we call in England a hoist, or an 'oist, according to our aspirations. Americans are not very fond of using their legs, so that elevators there have attained a much greater development than hoists with us. In some American buildings, however, they are a real necessity, as in the *Tribune* buildings at New York. I have had to call on the editor of the *Tribune* after the elevator had ceased to run (midnight), and fond as I am of stair-climbing, which is as good exercise for the legs as rowing for the arms, I should have preferred being lifted part of the way.

Empire State, The. New York State.

Engineer, used substantively for an engine-driver. As a verb, to engineer a road is to plan and work out the plans for it.

Enthuse, To. To grow enthusiastic, or to make others become enthusiastic.

Essence-pedlar. This euphonious name is applied to the skunk, for obvious reasons.

Euchre. A good card game, livelier and less difficult than whist, yet involving a good deal of science.

Euchred. As a card term, means to fail to make three points at euchre, after making or ordering up a suit. Merely to fail to make three means only the loss of a point, but to be euchred means to lose two points. Hence the expression is used for being foiled.

PHOTOGRAPHY AND THE PRINTING-PRESS.

THERE are many persons who regard the art of photography only as a ready means of obtaining the portrait of some relative or friend, or the image of some house or landscape round about which some pleasing memories and associations cling, and of which, therefore, it is desirable to have a reminder in the shape of an accurate picture. Or, perhaps, now that the photographic amateur is becoming such a very familiar, if not to say obtrusive, person, the art of sun-painting may, by the people adverted to, be regarded as a fashion or fad, which, like croquet, lawn-tennis, rinking, and many other amusements, will have its day and its earnest votaries, to be presently forgotten as some newer thing turns up for the attraction of the young and giddy.

But those of a more mature habit of thought, and who are therefore better able to gauge the signs of the times—those particularly who care to look over the columns of the technical journals, even though they may not find there any matter to arouse great interest—cannot but be aware that photography has of late years made rapid strides, not only as a faithful reproducer of the beauties of nature, but as an aid to nearly every branch of the arts and sciences. A brief review of one of the modern applications of photography will, we feel certain, interest a great number of our readers.

In one art at least the photographic plate is gradually working, if it has not already caused, a revolution. We allude to the art of wood engraving. Only a very few years back the process of producing a picture suitable for the

printing-press was briefly as follows. The artist drew his design on the boxwood block—the engraver cut that design—and the block afforded a certain limited amount of impressions before it was worn out and useless. Then the electrotype process came in. The soft block was no longer used in the press, but an impression in wax was taken of its engraved surface, and this waxen mould was subsequently used in the electric bath to furnish a shell of copper, or electrotype, which, when afterwards strengthened and mounted, would furnish a large number of impressions. The wood block itself was put away as an original from which other wax impressions and electrotypes could be taken without limit. But let it be borne in mind that, with the cutting of the block, the work of the artist—regarded as a drawing which would otherwise be valuable—was altogether destroyed.

Improvements in photography changed all this. The artist now executes his work on fine cardboard, with pencil and brush. The picture is in black and white, but not necessarily in lines, as in the old days of drawing on wood blocks. It is drawn in tints—that is to say, the various lights and shades are expressed by washes of colour made up with Indian ink and Chinese white—many of these compositions having a great likeness to the old-fashioned sepia drawings, but possessing a colder colour. The next stage in the process is to copy the drawing on to a wood block. It is here that the camera comes upon the scene, with an advantage not possessed by any other form of copying. The original can be reduced or enlarged to any size required. In practice, enlarging is never, or seldom, asked for; but the reduction of a large drawing to a small block is a frequent operation. This having been done, the block, bearing a most faithful representation of the original, is handed to the engraver, who rapidly translates its varying shades into sharply-cut lines, which accurately convey to the eye, by their varying proximity to one another, the force and meaning of the original work. And here we come to one of the most important features of the operation. The original remains intact and unaltered in every way, and has a market value depending upon the status of the artist who drew it. We recently saw a large collection of these black-and-white pictures, as they are commonly called. They had all been used for reproduction, and had done duty in various publications. They were now for sale, and the prices realised varied from twenty pounds down to as many shillings.

But this is not the only change that photography has brought to the engraver's art. In great measure it has superseded that art. So much so, indeed, has this result been brought about that many engravers who formerly had no difficulty in finding constant work have now so little to do that they have seriously to think of beginning the world afresh. This is the sad side of every improvement which increased knowledge renders possible. The individual suffers for the general good. A large proportion of the pictures which appear in our periodicals—including those of the highest class—have been drawn, photographed, and made ready for the printing-press without any aid whatever from the hand of the engraver. It seems at first sight little short of marvellous that the delicate and fragile image formed by the sun on a glass plate—an image so fragile that it is often torn by the accidental touch of the finger-nail—can by mere mechanical means be changed into a metal plate so rigid and strong that copies by tens of thousands can be obtained from it in the printing-press. That this is strictly within the truth our readers have lately had evidence in those star photographs which have recently appeared in these pages, and which were produced, as has been already stated, quite independently of the engraver's art. The daily newspapers occasionally reproduce pictures of a rough kind, which are also traceable to automatic processes; and here we have indications that the issue of a daily illustrated journal may become probable—it is certainly possible—in the near future.

The process by which a mere line picture (we mean one in which absolute black and absolute white are the only effects involved—a picture, that is to say, without greys or half-tones) can be reproduced is astonishingly simple. The operations depend upon the curious property possessed by a certain class of chemical salts—the dichromates of the alkalies—in rendering gelatine or any colloid substance insoluble after insolation, or exposure to light. Taking the common red salt, potassic dichromate, as a type of those mentioned, let us see how it enables the operator to change a line drawing into a block ready for the printing-press.

First of all, a warm solution of gelatine and water is charged with a certain quantity of the dichromate, or bichromate of potash as it is familiarly called. This mixture is brushed over a sheet of paper, which paper is then hung up in a dark room to dry. In the meantime a negative image on glass has been taken of the line drawing by means of the camera—an image in which the lights and shades are all reversed, and in which, therefore, the original black lines of the drawing are represented by lines of clear glass on a black ground. The negative is placed in a printing-frame, and is backed up with the prepared paper. It is now exposed to light for some minutes, during which time only those portions of the paper can be affected by such exposure as are comprised in the lines of the drawing—for those portions only of the glass negative will permit the light to go through it. When the right amount of exposure has been given, the negative and the paper are again taken into darkness, or darkness only relieved by red illumination, which has no effect on the sensitive chemical employed. The paper, even by this dim light, is seen to have a faint image upon it, but this is for the moment disregarded. It now receives a uniform coating of greasy ink, until every trace of its former appearance is obliterated. The paper is next transferred to a bath of hot water; and now a very curious thing happens. The bichromated gelatine has been rendered quite insoluble by the action of the light in certain parts, and those parts comprise the lines of the drawing. The rest of the surface is still soluble in the hot water, and immediately begins to dissolve. In a very few minutes this stage of the work is complete, and the original drawing stands revealed in insoluble lines covered with greasy ink. A zinc plate is now required, to the surface of which that greasy image can be transferred. The zinc is then placed in an acid bath, so that the metal, where not protected by the ink, is eaten away—and lo! the drawing is left in relief. This zincographic plate can now be mounted on a wooden block for direct use in the printing-press, or it can be employed for affording wax moulds from which any number of electros can be obtained. It need hardly be said that the cost of producing such a block is a fraction of the cost of one cut by hand.

We see, then, that a printing surface which can be used in the ordinary printing-press is obtainable by the action of light, coupled with certain chemical and mechanical operations, but dispensing from first to last with the work of the engraver. But the picture must be expressed in either lines or dots, or a combination of both, so that innumerable points are produced to which the printing-ink can attach itself. Many attempts have been made to soften the effect of these markings, so as to get some appearance of half-tone. The best method, perhaps, is that which employs a special form of paper for the original drawing. Specimens of such prepared

papers are now before us, and they exhibit a wonderful amount of ingenuity in their manufacture. Here is one faced with a surface of china clay. Upon this surface is described a series of close parallel black lines, such as a wood-engraver would employ on a block to indicate a blue sky. These lines are in relief, so that, as an artist executes his drawing upon the paper in soft lithographic chalk, the lines catch hold of the black composition and retain it, forming eventually a network of microscopic dots, which will readily lend themselves to the requirements of the zincographic process just detailed. But the paper can do more than this. With a scraper or knife the artist can work upon the surface, so as to cut away the lines, leaving pure white underneath. The white scraped portions then indicate the high lights of his drawing, the chalk-marks represent the deepest shadows, while the untouched lined surface of the paper affords the half-tones. Other effects can be produced by using grained papers of different kinds, and ordinary chalk drawings on paper can be well imitated for production in the printing-press by these methods.

The production of "process blocks," as they are called, to distinguish them from wood engravings, is now becoming a very important branch of commercial enterprise. Broadly speaking, we are bound to admit that very few of these blocks equal in beauty a fine wood engraving. But the attention of inventors has been aroused to the importance of the work, and new processes are constantly being brought forward. In the hands of Angerer of Vienna, Goupil of Paris, Meisenbach in this country, and many others, some very beautiful results have been already achieved. It is evident that perfection is not far off. In this brief notice of a new but important phase of photography, we have been necessarily confined to bare outlines. It may be said, however, that all these processes depend in the first instance upon the fact that certain chemical salts render gelatine insoluble after exposure to sight. This important discovery was made by Mungo-Ponton so long ago as the year 1839.

MIND ACTING ON BODY.

By Richard A. Proctor.

WHAT might be hoped from minds of exceptional power we may learn from several instances which have been recorded in the history of medicine. Among the most remarkable is the case of Andrew Crosse, the electrician—a case so remarkable, indeed, that, were it open to doubt, one might be disposed to reject it as incredible, or at any rate as explicable in any other way than as an instance of the power of the mind over the body.

Crosse had been bitten severely by a cat, which on the same day died from hydrophobia. He seems resolutely to have dismissed from his mind the fears which must naturally have been suggested by these circumstances. Had he yielded to them, as most men would, he might not improbably have succumbed within a few days or weeks to an attack of mind-created hydrophobia—so to describe the fatal ailment which ere now has been known to kill persons who had been bitten by animals perfectly free from rabies. Three months passed, during which Crosse enjoyed his usual health. At the end of that time, however, he felt one morning a severe pain in his arm, accompanied by severe thirst. He called for water, but "at the instant," he says, "that I was about to raise the tumbler to my lips, a strong spasm shot across my throat; immediately the terrible conviction came to my mind that I was about to fall a victim to hydrophobia, the consequence of the bite that I had received from the cat. The agony of mind I endured for one hour is indescribable; the contemplation of such a horrible death—death from hydrophobia—was almost insupportable; the torments of hell itself could not have surpassed what I suffered. The pain, which had first commenced in my hand, passed up to the elbow, and from thence to the shoulder, threatening to extend. I felt all human aid was useless, and I believed that I must die. At length I began to reflect upon my condition. I said to myself, 'Either I shall die or I shall not; if I die, it will only be a similar fate which many have suffered, and many more must suffer, and I must bear it like a man; if, on the other hand, there is any hope of my life, my only chance is in summoning my utmost resolution, defying the attack, and exerting every effort of my mind. Accordingly, feeling that physical as well as mental exertion was necessary, I took my gun, shouldered it, and went out for the purpose of shooting, my arm aching the while intolerably. I met with no sport, but *I walked the whole afternoon, exerting at every step a strong mental effort against the disease.* When I returned to the house I was decidedly better; I was able to eat some dinner, and drank water as usual. The next morning the aching pain had gone down to my elbow, the following it went down to the wrist, and the third day left me altogether. I mentioned the circumstance to Dr. Kinglake, and he said he certainly considered I had had an attack of hydrophobia, which would possibly have proved fatal had I not struggled against it by a strong effort of mind."

It seems to me not unlikely that this case, besides illustrating the power of the mind in arresting disease, might serve, if carefully studied, to throw light on the nature of hydrophobia. We must assume, it should seem, that the mind can only act on the body by means of the nerves, which indeed may be regarded as simply outlying branches from the grand nerve-trunk—the brain. By strong mental effort the nervous system, either as a whole, or in some special region, is thrown into some condition which is not its normal condition, and in this abnormal state influences in some special manner the other tissues, either of the body as a whole, or of the part of the body in which the nerves are thus thrown into an abnormal state. Now, it seems by no means impossible to ascertain experimentally what is the change of condition thus brought about by mental efforts to direct attention to special parts of the body. The recognition of the possibility that the progress of the hydrophobic disease in the body may be arrested by interposing in its way, as it were, a barrier of nervous system in this abnormal condition might conceivably suggest some specific remedy for the disease, some process or medicament by which this abnormal condition might be brought about in cases where the mind and will were not sufficiently powerful to produce such an effect without aid from without.

Remembering the resemblance between some of the phenomena of hydrophobia and of lock-jaw, the following case, in which the cure of lock-jaw was attributed to the use of metallic tractors, further illustrates this particular point, for it was sufficiently demonstrated subsequently that all the results of metallic tractorism could be equally well produced with wooden or bone tractors painted to resemble metallic ones—in other words, that they were simply effects of imagination, strongly excited by the belief that metallic tractors have a powerful curative influence. The account is given by the late Mr. John Vine Hall, of whom Dr. Todd remarks that his veracity was unimpeachable:—"Mrs. P., a poor woman in Wharf Lane, Maidstone, was seized with a lock-jaw four days ago, and continued in a most deplorable state, attended by a physician and a surgeon, till this morn-

ing, when she was completely cured in fifty minutes by the application of the tractors. The medical gentlemen had been exerting themselves to the utmost, in the kindest manner, and one of them said he would give a hundred guineas if he could save her life. This gentleman came into the room while I was in the act of using the tractors, which he had never seen before, but kindly said they should certainly have a fair chance, and he directed me where to apply them with the greatest advantage. I continued the operation for forty minutes without any apparent benefit, and then, giving the tractors into the hands of the surgeon, returned to my own house, awaiting the issue of their further application. In about twelve minutes the surgeon (Mr. S.) came breathless with haste and delight to inform me that he had himself continued the use of the tractors only ten minutes when the poor creature opened her mouth. Mr. S. was so fully persuaded of the efficacy of the tractors that he immediately purchased a pair for his own use. Mr. S. writes: 'The case is yours, the suggestion was yours: I merely continued the employment of the measure from the apparent helplessness of medical means in relieving the distressing complaint. Although previously to the employment of the tractors I had utterly given up the idea of saving my poor patient; although I feared medicine would prove wholly inefficacious, yet I am not prepared to say that certain death would have been the result; but I do not for a moment mean to impeach the effect of the tractors in this case. I feel conviction that they produced the cure.' "

In passing I may note, with Dr. Todd, my surprise that after it had been conclusively proved by the experiments made by Dr. Haygarth and others with wooden tractors, that such cures as the above were really due to the effect of imagination, they should therefore have ceased to pay further attention to the matter. The result of their experiments was more interesting than would have been any demonstration of the potency of metallic tractors. They had established, in fact, the existence of a curative power in nature far more wonderful, and promising to be of far greater, because of far wider, utility than these mystical instruments. Yet, having effected this great discovery, they treated it as if it were of no value whatever. Are we to suppose that if, when death was gradually approaching nearer and nearer to Mrs. P. of Maidstone, S. the surgeon and Vine Hall the tractorian, had known what was afterwards established by Haygarth and others, they would have declined to use the means by which (through the influence on her imagination) the poor woman was actually cured? The conduct of Haygarth and the rest, after the efficacy of metallic tractors had been disproved, suggests that this would have been the course of medical men acquainted with Haygarth's results. In other words, having proved that a certain very potent method of cure derives its power from a source other than had been supposed, doctors seem to have agreed that therefore this remedy should no longer be employed, though the very researches by which they had detected the true nature of the remedy had at the same time indicated its wonderful efficacy. It is as though a physician, called in by a family doctor to counsel him about a patient, should suppose that a certain medicine which had proved of great service before his arrival contained quinine; but finding on analysis or otherwise that it contained other ingredients, and no quinine at all (satisfying himself, also, in the meanwhile, from observation, that it was of great service to the patient), he should incontinently throw the bottle out of window. This, as Dr. Todd well remarks, "is at least as astonishing as that the public should believe in, and allow themselves to be cured by, the metallic tractors of Perkins, and be content to refer the influence to galvanism."

The case of Irving preaching under an attack of cholera, and actually overmastering that terrible disease in the struggle, is perhaps familiar to many of my readers. But it so remarkably illustrates my subject that I can ill afford to omit it. During the cholera season of 1832, he was seized with "what was in all appearance, and to the conviction of medical men when described to them, that disease which had proved fatal to so many of our fellow-creatures." He had risen in perfect health. But by breakfast-time he had become very cold, and was in great agony. The usual symptoms of cholera presently supervened. A medical man informed Dr. Todd that to his knowledge Irving was in a state of dangerous collapse during one part of the morning. "With sunken eyes, pallid cheeks, and an altogether ghastly appearance, he tottered to the church, a quarter of a mile distant, and found another minister officiating for him." He was tempted, he tells us, to turn back, but summoned resolution to send a message to his brother-minister that he would shortly take his place. In the meantime he stretched himself on three chairs in the vestry before the fire. "Even as I shifted my position," he said, "I endured much suffering, and was almost involuntarily impelled to draw up my limbs in order to keep the pain under. Nevertheless, when I stood up to attire myself for the pulpit, and went forward to ascend the pulpit-stairs, the pains seemed to leave me." With dimmed sight, his head swimming, and his breathing laboured, he grasped the sides of the pulpit, and looked wistfully around, wondering what was to follow. Be it remembered that in his eyes disease was sin; faith only was needed to overcome all other bodily ills save those due to accident or old age; and that disease seemed now likely to master him was evidence, as he thought, that he had sinfully lost hold of faith. It was a moral struggle (at least, it seemed so to him), not a bodily contest in which he was engaged. As he thus stood contending against the evil spirit in imagination, but in reality bringing by strong effort of the will his natural energies to meet the progress of physical disease, the crisis came. In an instant "a cold sweat," he tells us, "chill as the hand of death, broke out all over my body, and stood in large drops upon my forehead and hands. From that moment I seemed to be strengthened." For more than an hour he preached with a fervour unknown to him—fervid preacher as he ever was before. He walked home, eating little. In the evening he preached in a crowded schoolroom, and next morning rose before the sun, strong and hearty as before the attack.

An agency competent, as these and many similar cases which might be cited seem to show, to check the progress of such maladies as hydrophobia, lock-jaw, and cholera, is one which deserves to be dealt with, not as an interesting illustration of psychological and physical relations, but as a potent remedial force worthy to take its place beside, if not above, any of the medicaments which doctors are at present in the habit of employing. But apart from this, the circumstance that powers so remarkable exist in the cerebral faculties suggests other purposes to which they might be applied. In the phenomena of hypnotism, or artificial somnambulism, we have some very striking evidence on this point; but it would lead us too far from our present subject to consider these, except so far as they illustrate the influence of the mind on bodily disease. In this respect they supply some of the most remarkable evidence we have to consider.

Let it be premised before considering the phenomena of hypnotism, mesmerism, or whatever we choose to call them, that the theory of their being due to animal or any other sort of magnetism has been abundantly disproved. Of course, if it were otherwise, they would fall entirely outside the range of this essay. Nor, again, can they be in any way attributed to the influence of one mind on another, except in

the way of suggestion. The cure of the naval officer already considered might be attributed in *this* sense to the action of the surgeon's mind on the patient's body, for it was the ideas advanced by the surgeon which excited the necessary action in the mind of the patient whereby the progress of disease in his body was checked. But as in that case the immediate remedial agent was (if the case was interpreted correctly) the mental action of the sufferer, so all the phenomena of hypnotism are due to cerebral processes in the subject, these processes being simply initiated by the suggestions, more or less obvious, of the operator. I have said that the magnetic interpretation has been disproved, and equally it can be asserted that the supposed influence of the operator's mind on the subject's body has no real existence. I have not space here to consider the evidence; but full evidence has been obtained that precisely as all the results of metallic tractorism (a special case of animal magnetism, as was supposed) can be obtained with wooden ones, so all the phenomena attributed to animal magnetism generally can be obtained without any magnetic influences, while the phenomena which had seemed to be excited by the active will of an operator are obtained in equal degree when he purposely diverts his thoughts to other matters. The only circumstance remaining unexplained in the phenomena of hypnotism is the strange power which the subject often possesses, or seems to possess, of reading the thoughts of the operator. But this may probably be regarded as simply illustrating the abnormal powers which the mind of the hypnotised possesses for the time being; and indeed it is certain that the power of mind-reading acquired at such times (probably, merely the power of recognising minute changes of expression, attitude, gesture, and so forth) is by no means limited to the operator; in some of the most remarkable and the best-attested instances the hypnotised person has been able to read the thoughts of any person to whom his attention has been directed.*

Setting aside, however, all explanations based on hypotheses inconsistent with the known laws of physics, or on impressions supposed to be produced by one person's mind on another person's body—in fact, all such explanations as science is bound to reject—we find in the phenomena of hypnotism the most wonderful illustrations of the power which the mind has over the body. We might consider here a number of cases illustrating the cure of paralysis and affections more or less obviously depending on the state of the nervous system; but it will be better to limit our attention at present to the far more striking cases in which a definite change has been produced in the condition of parts of the body which might be supposed altogether beyond the mental influence—that is, so far as their organic structure was concerned.

In relation to one remarkable case of the former kind described by Dr. Procter, of York (see the "Zoist" for 1851), in which the patient was averse to the trial and expected no result, whereas the cure was as complete in his case as if he had been full of faith in the magnetic passes, it is necessary to make some remarks. The case is not one which need be described here, but the inference that because of the patient's unbelief we must reject the theory that imagination had aught to do with the matter is one to be carefully considered. Dr. Todd has well pointed out that the essential point in these cases is not the encouragement of the expectation of cure, but the direction of the attention to the part of the body which is affected by disease. The unbelieving patient who at the same time is indifferent to the experiment would doubtless be an unpromising subject for the mental method; but a patient who took sufficient interest in the passes and other outward signs of mesmerism to be opposed to them, would probably be quite as favourable a subject for the method as one who took the same degree of interest in them because he believed in their efficacy.

The most striking illustrations of the effect of imagination excited, as when hypnotism or Braidism is produced, are those in which partial blindness has been cured, actual opacity of the cornea being removed. Where very weak sight has been quickly cured, we may assume that the weakness was in the optic nerve, or otherwise depended on the state of the nerves, but it will presently be seen that in other cases the structure of the eye has undergone a definite organic change.

To the former and less remarkable class of cases belongs the cure of Mrs. Stowe by Braid. She was forty-four years old, and had used spectacles for twenty-two years, not being able without them to distinguish even the capital letters of advertisements in a newspaper, nor the large heading of the paper. After being hypnotised by Braid for eight minutes she was able "to read both the large and small heading, and day, month, and date of the paper. Her sight continued to improve—she could thread her needle, No. 8, without spectacles;" and Mr. Braid states that this remarkable increase of visual power has been retained.

The case of Miss R. was equally remarkable. She had not only suffered from ophthalmia, but as a result of the partial blindness thus occasioned had met with several accidents, some of which had further injured her eyes, insomuch that she was totally blind. She was placed under the care of a physician at Dublin during six weeks, and improved to some degree, "for the iris had become somewhat sensitive to light, and she was able to discern large objects, but could neither see to read nor write." She returned home, but her eyesight remained without further improvement, and at length her medical attendant recommended that she should be placed under Mr. Braid's care. He found no apparent physical imperfection to account for her impaired vision, nor at this time did she suffer from any pain about the head or eyes. She could not discern a single letter of the title-page of a book placed close to her, though some of the letters were a quarter of an inch long. Having placed the patient in the condition of artificial somnambulism, Mr. Braid "directed the nervous force to the eyes by wafting over them, and gently touching them occasionally, so as to keep up a sustained act of attention of the patient's mind to her eyes and the function of vision." (Some objection must be taken in passing to the statement that the nervous force was directed to the eyes, because it involves an assumption. The attention was directed to the eyes; what intervened between this act and the observed change in the patient's condition is a matter to be inferred, not assumed.) In about ten minutes she was aroused from the hypnotic trance. "I now presented before her the title-page of the same book, when she instantly exclaimed with delight and surprise, 'I see the word "commerce!"' pointing to it. I told her she would see more than that presently, and in a little while she exclaimed, 'I see "commercial,"' then 'I see "dictionary,"' and shortly after, 'I see "McCulloch;"' but she could see nothing more. I told her that after a little rest I felt assured she would see still smaller print; and after a few minutes she was able to read 'London: Longman, Green, and Longmans.' Such

* It would seem, indeed, probable that the special cerebral condition produced in the hypnotised may be excited at will by some persons; without the assistance of any operator they become subjects of their own mental control thus specifically exercised. Some remarkable cases of mind-reading (amongst others may be mentioned two described by Dickens—see Forster's *Life*—as exhibited by a French conjurer at the time of the Anglo-French alliance) seem explicable in no other way, and in this way explicable without any mysterious or supernatural agencies (which are, of course, *ex necessitate*, excluded from the scientific discussion of such matters).

was the result of my first process. After a second hypnotic operation the next day the patient could read, when first aroused, the whole of a title-page of a pamphlet, and in about five minutes after, she read two lines of the text. After another operation the same day she could read the small close print in the Appendix; and was able the same evening to write a letter home reporting progress for the first time for twelve months. She only required two more hypnotic operations, when she was found able to read the smallest-sized print in a newspaper, after which she left me quite cured, and, as I have heard, she continued well ever since."

The explanation in such cases would seem to be unmistakably that indicated by Braid in the expression to which I have taken exception above. By the actions which directed the attention to the act of vision, the nervous force would seem to have been directed along the channels from which some cause or causes had before unfortunately diverted it—the optic nerve and the various ramifications extending from it. These channels of communication between the brain and the eyes having been thus again opened, remained thenceforth as they had been before they had been obstructed. Be it noticed that the words here used—nervous force, channel of communication, obstructed, opened, and so forth —must not be understood in their literal sense; they are simply convenient forms of expression for qualities, processes, &c., about which we know in reality very little.

(*To be continued.*)

HOW THE BIBLE CAME TO US.

By a Student of Divinity.

(*Concluded from p. 215.*)

THE NEW TESTAMENT.

THE history of the collection of booklets which we call now the New Testament is very different in nature from that of the larger collection called the Old Testament. As we have seen, the Jews gradually accepted more and more from among the old works which at first were for the most part rejected: and so such materials as the books of Judges, Samuel, and Kings, disregarded by Hilkiah and Huldah, took their place in the sacred collection; while afterwards the ill-compiled and comparatively unsatisfactory books of Chronicles, Ezra, and Nehemiah were included. Later still other works, some better, some worse, but all wanting in the antiquity which probably was the real secret of the original idea of inspiration, were added to the varied conglomerate.

With the New Testament the case was different. Upwards of fifty gospels existed, from among which four only were selected; many very remarkable acts were attributed to the Apostles besides those recorded in the accepted Acts; all manner of letters, from epistles by Abraham to others equally authentic by Pilate and Mary, and even Christ, asserted claims to acceptance besides those few which bore, more or less satisfactorily, the feeble critical analysis which the knowledge of the second and third centuries could apply.

We have no means of determining with any accuracy the degree of knowledge attained by the Jews before our era; for we see no traces of any process of selection. Everything old and Jewish seemed to them sacred. But, comparing what the Christians of the second and third centuries accepted with what they rejected, we can form some idea, not only of their acumen, but of their knowledge. We see indeed, noting how certain stories which a few centuries before would have been accepted unhesitatingly were sifted out as incredible, that only a moderate advance in knowledge would have enabled them, by sifting out yet other writings, to have saved some modern theologians an immense amount of trouble and some twinges of conscience (we may well hope) in the painful work of reconciling nescience with knowledge and inconsistent narratives with each other.

For this reason, as giving us a measure of early Christian critical ideas, we may as well, in the first instance, consider the nature of the rejected works, of which it has been justly remarked that they contain much which might easily be reconciled with the contents of the received books, though (happily or unhappily, according to the point of view one may adopt) they also contain a great deal which even the most advanced theological ingenuity would probably be unable satisfactorily to explain.

In one gospel we have an account of the childhood and early life of the Virgin Mary. It would appear from this record that, at the age of three years, the little lady was brought to the Temple, and accomplished the quasi-miraculous feat of walking up the steps without help. The choice of Joseph as Mary's future husband was determined by a dove, who came down from heaven (where doves, it is well known, have their home, and where marriages are made) to announce the selection of the carpenter of Nazareth as her spouse. In the Gospel of the Infancy we have two stories of the childhood of Christ, which even in those uncritical days must have seemed *par trop fort*. At the age of five, he amused himself one day moulding clay birds; being chidden for this, he gave them life and they flew away. This use of means towards an end which, since it was eventually obtained by a miracle, might as well have been attained by a single miraculous effort, reminds one of the blind man cured by clay and saliva, who (unless these are supposed to have a special ophthalmic efficacy) might have been as readily made to see at once. Another miracle of the Infancy reminds us of the fig-tree cursed for barrenness. A boy had beaten the infant; but Jesus, far from omitting to resist evil, caused him to fall dead immediately. The Gospel of Nicodemus gives the names of those who accused Christ before Pilate. We also find that one of the women cured by Christ was called Veronica; and we learn what happened when Christ "descended into hell."

The record of the acts of the apostles by Abdias, who came immediately after their time, is chiefly remarkable, perhaps, for the account of the contest between Peter and Simon the magician, before Nero. The contest, according to this veracious history, ended unpleasantly for both. The last encounter was a sort of flying-match. Simon floated fairly high at this *séance*, and appeared likely to triumph, when Peter made the sign of the cross, on which Simon became submissive to the customary action of gravity, and falling heavily, broke both his legs. Nero was annoyed at this, for he would seem to have made Simon a favourite, and he therefore caused Peter to be crucified head downwards. No miracle intervening, Peter came thus by his death.

Among the forged letters may be mentioned two by Pilate in singularly bad Latin to Tiberius, and several by Christ, including one written to Abgarus, King of Edessa, which must clearly have been miraculous, since there was no king of Edessa in Christ's time. There were also letters by Mary, and several passed between Seneca and St. Paul which St. Jerome and St. Augustine were content to receive as authentic.

But in fact the number of forgeries of this sort which appeared in the second and third centuries was enormous. The piously disposed seemed to think they could in no

better way show their zeal than by lying zealously in the cause they had espoused.

From amidst all this heap of piously intended forgeries the selection of trustworthy material must have been difficult indeed. One is disposed to wonder what a Tischendorf, if a man with knowledge and acumen such as his had existed in those days, would have made of the task. The Hilkiahs, Shaphans, and Huldahs of old had simply to form an opinion about documents whose origin and greater or less antiquity they were acquainted with. Ezra and Nehemiah had a similar task, and not being so exacting accepted more, while in later ages nearly everything Hebrew was accepted as sacred until close upon the fall of Jerusalem. But those who, in the second century of the Christian era, had to determine what was good, indifferent, or bad, in the immense mass of stories which so many (as the author of the third gospel tells us) had "taken in hand to draw up," had a much more difficult task.

We have in reality no trustworthy evidence as to the real authorship of any of the four gospels, or of the Acts; for even the internal evidence, such as it is, is questionable, on account of the prevailing taste for literary forgery. Those who first tried to draw up anything like a canon of the New Testament were neither very critical nor very learned; and if they were able to form an opinion as to the authorship of some original form of any one of the gospels, they would yet have been quite unable to distinguish between the genuine text and interpolated matter.

The study of a single book may suffice to show what knowledge the critics of those days had and had not. There is a tradition that the Gospel of Matthew was originally written in Hebrew, but there is very little evidence, or none at all, in its support. A peculiarity of the author of this gospel, whoever he may have been, is his anxiety to devise fulfilments of misunderstood prophecies. He was misled by the redundancy of Hebrew poetical expression resulting from the recognition of something especially beautiful in repeating the same idea in different words, or in the same words variously arranged, as in the lines—

> At her feet he bowed, he fell, he lay:
> At her feet he bowed, he fell:
> Where he bowed, there he fell down dead.
> *Judges* v. 27.

This peculiarity belongs to the earlier stages of poetical development, and is especially characteristic of the poetry of semi-savage races.* But the writer of the first gospel was not aware of this, so he deemed it necessary, for the conversion of the Hebrews to Christianity, to present Christ as not only entering Jerusalem on "an ass," but also moreover on "a colt, the foal of an ass" (the method not stated); whereas the author of the second gospel is content with the colt alone. It should be noticed, however, that it is the author of the fourth gospel who thought it necessary to show how not only were Christ's garments parted, but lots were cast for his vesture, a rendering which (apart from the mistaken idea about prophecy being intended) would probably have much surprised the ancient poet who lamented among other griefs the abstraction of his clothing.

It was also the author of the fourth gospel who recognised in the saying, "a bone of him shall not be broken," a prophetic indication of death rather than of safety! It was, however, the author of the first gospel who made the most grievous mistake of all—a mistake unintelligible unless we remember that an illiterate Hebrew, even though he might have heard the greater part of the ancient scriptures read often in the synagogue, would remember only scattered verses, not their context. Anyone who reads Isaiah, chapter vii. verses 11 to 17, and chapter viii. verses 3 to 8, will see that the words, "Behold, a virgin shall conceive," &c., though they related to a "sign" and purported to convey a prophecy, related to no such miracle as the incarnation, and conveyed only a prediction about matters which were to follow within two or three years, and did so follow according to the prophet's account. One who was then a virgin was to become presently a mother, precisely as many maidens of to-day will in the ordinary course of events be mothers before this day twelve months. The child was to be called Immanuel; and he received that title, besides the less euphonious names Maher-shalal-hash-baz; and before he had knowledge to cry, "My father" and "My mother," the King of Assyria was to achieve a triumph, then perhaps somewhat obviously impending. But the writer of the first gospel, with the words of the well-known verses in his memory and the context forgotten, perhaps also with some vague recollection of a tradition belonging to the old and almost universal belief in the birth of the Sun-god from a virgin, supposed the birth of the Messiah was referred to, and spoke of events long after Isaiah's time, as occurring that that supposed prophecy might be fulfilled!

While we may wonder that these blemishes in the first gospel, and kindred errors in the others, natural enough in the writings themselves, should have escaped the carping race of critics, even in the second century, we must not wonder that they noticed none of those mistakes which modern science has detected. Doubtless these were few, and those not likely to be Christians, who, in the first six centuries even, would have noticed the mistake involved in supposing that from an exceedingly high mountain all the kingdoms of the earth could be seen at a single view. Probably there were none, and assuredly there were no Christians, who knew that the phenomena attributed by the writers of all four gospels, as well as of most of the remaining books of the New Testament, to possession by evil spirits, were in reality due to causes purely physical.

On the whole, we may admit that, if any among the multitudinous gospels existing in the middle of the second century were to be retained, the four gospels which seem to have definitely taken their place in the canon of the New Testament before the end of that century were deservedly selected; though it must also be admitted that, while a very slight diminution of critical keenness would have brought in many more, a moderate increase of acumen would, at any rate, have caused the excision of many interesting but questionable passages now remaining in each of the four narratives retained.

The Muratori fragment—if genuine, as seems likely—shows that a sort of canon of the later scriptures had been drawn up a generation at least before the time assigned by the author of "Supernatural Religion" as the earliest date to which the acceptance of the four gospels can be referred. The epistle of Barnabas, though doubtless a forgery, shows that even earlier some of the sayings embodied in the gospels were regarded as scriptural,—though that, of course, is not saying much. Again, we learn from Dionysius, Bishop of Corinth about 170 A.D., that the epistle of Clement had been read in his Church from ancient times; and in this epistle, whose authenticity seems probable, there are many quotations of sayings of Christ, such as are found—though never in the same precise words—in the four gospels. Hermas, Ignatius, Polycarp, and Justin Martyr, ranging in time from the latter half of the first century to the middle of the second century, give corresponding evidence. It may

* For an excellent example of this style, see the song of triumph of Jim, the Australian savage, in "Never Too Late to Mend." "I slew him, he fell; *I* slew him, he *fell*; I slew *him*, *he* fell; and so on. This is the style of the savage. The song of Deborah and Barak is a fuller development of the same method.

be urged that as they never use the exact words of the now accepted gospels, their evidence is rather against than in favour of the belief that these gospels were accepted in their day. But it may fairly be answered that in those days exact quotation would be the exception rather than the rule. It must, however, be admitted that, even if this would explain their *never* quoting exactly, there is simply no evidence in these letters in favour of the accepted four gospels as against (1) the rejected ones, or (2) the possible existence of others long since lost, or (3) even the existence of old Hebrew records of moral sayings of much greater antiquity (mistakenly attributed to Christ). For in any one of these three cases Clement, Hermas, and the rest would have written as they did; while, were they actually quoting from the accepted gospels, they might have been expected to have once, at least, quoted correctly.

Mr. Matthew Arnold has noted one strange class of exceptions to this incorrect quotation, if quotation indeed it was. He observes that quoted prophecies are given in the very words of the gospels, even when these words differ from those in the Septuagint. It is hardly necessary to insist on the significance of this peculiarity combined with the incorrect rendering elsewhere. We see that the ancient letter-writers actually quoted, and as clearly that they could not have been quoting from the gospels we have, but that in these gospels certain prophecies were quoted from some more ancient record.

With regard to the Epistles and the Book of Revelation, similar difficulties exist. The doubts which long prevailed as to the Epistle to the Hebrews, the Epistle of Jude, the second Epistle of Peter, and the second and third Epistles of John, show that something like the same difficulties which had limited the development of the Old Testament limited also the growth of the New. But with the progress of time, objections clearly recognised by the critics of the second and third centuries disappeared, and when Jerome wrote his Latin version of the Bible—the Vulgate—the doubts which he himself recognised had so far lost their efficacy that the New Testament in his hands assumed practically its present form.

We may hereafter give a sketch of the interesting history of Bible Revisions, and of the somewhat amusing but suggestively instructive opposition which they successively encountered.

A DEAD WORLD.

By Richard A. Proctor.

(*Continued from* p. 212.)

THAT the stages of the moon's life would be very much shorter than those of our earth's life, follows, as we have seen, from the consideration of her smaller mass. But the stages of her life would not only be shorter than those of the earth, they would be different in character, because of the different amount of air and water, and also because the lunar atmosphere before it became air such as we have (only rarer) must have been very different in quality from our air in its old unbreathable state.

It has been shown by geologists that the various salts found in the sea must have belonged to it from the beginning. The familiar explanation that they were washed into the sea by rivers is no explanation at all: as a matter of fact the substances thus washed down by rivers came to be present in the solid crust by the drying up of former seas. We can form from the constitution of sea-water some idea of the horrible kind of atmosphere which our earth originally possessed. So also can we from many of the substances which we find in the earth's crust. There was sulphurous acid, and sulphuretted hydrogen (savouring of rotten eggs, though it could not have suggested their presence in days before as yet any chickens had appeared), carbonic acid, hydrochloric acid, and other highly disagreeable vapours. We have only to imagine what would happen if our earth were warmed up again, to see what must have been her state before she cooled. Nay, as she is kind enough to warm herself up locally at times, in sufficient degree to emit the very vapours which must of yore have been permanently outside her crust, we can tell by actual observation what they were. As the temperature beneath the earth's crust rises, the following gases and vapours are successively poured forth: carbonic acid gas (which chemists now call carbon dioxide), sulphurous acid, sulphuretted hydrogen, boracic acid, and hydrochloric acid. How pleasant an abode our earth would have been in her youth (independently of her high temperature) for breathing animals, may be inferred from the state of things formerly existing in the Avernian Lake, across which no bird could fly with life. The showers falling from the hot air of those days would be by no means showers of pure water. Boracic acid in the liquid state may not sound very terrible, but boracic acid has played the very——–a very important part, we would say—in modifying rock substances in volcanic districts, and when it fell in showers must have greatly altered the character of the earth's hot crust. Sulphurous acid might be as innocent as rose water for anything that its name may perhaps imply to many; but when we speak of fiery hot vitriol, everyone begins to recognise a substance that would probably have produced somewhat more marked changes on the hot crust of the earth than would a drizzle of ordinary rain on the fields and plains of the earth today. Ammonia and various compounds of carbon, nitrogen, and hydrogen, must have been present in the old atmosphere of the earth, and in various degrees of dilution with water must have been very effective as denuding agents.

Now it is easily seen that the various stages of the earth's vulcanian history must not only have been very different from those of the moon's, but that the records left in the crust must have been very differently treated. For example, the formation and the active existence of great volcanic craters on the earth probably preceded the formation of great mountain ranges. (I am not here referring to the various steps in the formation of a mountain range, but to the era of mountain forming as distinguished from the era of great crater formation.) On the moon there seems to have been no great era of range forming, and such mountain ranges as were formed probably began and ended their careers while the great craters were still active. But not only do we thus find a very different relation existing between mountain ranges and great craters on the moon and on the earth respectively, but we find that the records of the two forms of crust disturbance are in a very different state. On the earth all the original great craters have been so worn down and denuded that nothing but their basal wrecks remain; on the moon the great craters show their vast dimensions as originally formed, or where we see signs of important changes, the changes are those produced by subterranean not by subaerial action.

All this is readily explained as soon as we note the natural results of—1st, the relative shortness of the stages of the moon's life; 2ndly, the smaller relative quantity of water; and 3rdly, the smaller relative quantity of air.

The earlier forms of volcanic disturbance on the moon would resemble closely enough, in all probability, those which took place in the corresponding parts of the earth's

history. Doubtless the earth had large craters like those which still remain in the moon. But then in the earth's case there has been a much more thorough wearing down of those upraised regions. There has been more water to do the work by sea action, by river action, and by glacial action; there has been more air to help in the work by the action of rain, wind, snow, and storm; and there has been much more time for all these processes to take effect. Similar considerations apply, indeed, to the earlier stages when our atmosphere was denser, more complex, and more destructive alike by its own action and by the action of the various fluids formed by condensation out of the unpleasant vapours present in it. Now even a planet cannot at once eat its cake and have its cake. If our earth has had water enough, air enough, and above all time enough, to wear down in great degree the records of the first stages of its vulcanian career, the immense outbursts of molten matter, the vast craters, the mighty wrinkles and corrugations, then naturally these records can no longer exist in their original dimensions on the earth. But it is equally clear that the corresponding records will remain on the moon, where there has been much less water, a far rarer air, and a much shorter time during which denuding forces of air and water could work.

We can at once see a reason then why on the moon the immense craters which are much earlier vulcanian products than mountain ranges, remain still extant. Many of the larger and older ones show signs of denudation, which we may probably regard as having been brought about when the moon's atmosphere was still in its early state, loaded with active acids, still intensely hot, and capable of producing marked effects on the intensely heated crust. But far the greater number of the lunar craters are manifestly in the state in which they were first formed. The denuding forces on the moon died out long before there had been time to wear any but the earliest craters down, or wholly to wear down any.

On the contrary, there are naturally few mountain ranges of great size on the moon. The mountain ranges are products formed out of the materials of previous formations; and if the great craters remain, or have been very little reduced by denuding action, it follows that there has been very little material available for mountain-making, and few mountain ranges therefore have been formed.

Still, the great range of mountains called the Lunar Apennines shows that we must consider mountain-making on the moon in some degree, unimportant though this part of the moon's vulcanian history may be, compared with the corresponding part of the earth's. We may expect to find that the great craters have in some degree been worn away to provide materials for that lofty range of mountains. And if we assume, as we fairly enough may, that the formation of the Lunar Apennines corresponded with the formation of terrestrial mountain ranges, then we may reasonably look for the traces of just such processes as geologists have recognised in the development of the Alps, Rocky Mountains, and Himalayas on the earth.

It will be found that the search for such evidence leads to some very curious results, not only justifying the belief that the Lunar Apennines were formed like the terrestrial mountain ranges, but enabling us to interpret features of the moon's globe which hitherto had remained unexplained.

In the first place we find the Lunar Apennines between two immense plains, the so-called Sea of Serenity on the east (or what would be the east to a lunarian), the so-called Sea of Showers on the west, each having an area of many hundreds of square miles. These great plains are manifestly great tracts on which finely divided matter has been deposited, as on a desert region like Sahara, or—more probably—as on the floor of a great sea. Regarding them as originally oceans, we see that the mountain range occupies such a position as would correspond with the formation of mountain ranges, as this process has taken place on the earth. We may suppose then that the matter out of which the Lunar Apennines were formed was deposited in a great troughlike depression, formed along a region where the crust had yielded in a far earlier stage, and whence molten matter had been extruded. Judging from the height of the Lunar Apennines, we see that the depth of sedimentary matter deposited in that depression, as it slowly sank below the level of an ancient Lunar Sea (originally extending over the whole space occupied by the Seas of Serenity and Showers), must have been several miles. This range then assuredly speaks to us of many hundreds of thousands of years, during which the waters of a vast sea beat on the shore lines of ancient lunar continents, receiving from lunar rivers the matter worn from those continents by lunar winds, and washed down by lunar rivers. (Of one of these rivers, the immense mouth can still be recognised not far from the great crater Plato on the east of that great lake.*)

The steady sinking of the sea floor all round the immense seam thus formed gradually pressed the matter deposited in a troughlike depression into the form of a ridgelike elevation. (The reader anxious for technical expressions—which have the advantage certainly of giving the appearance of much learning at a very cheap rate—may speak here, if he likes, of subclinal and anticlinal; but the actual shapes are perhaps as well indicated by speaking of troughs and ridges.) We may well believe that intense heat was developed in the process, and much of the sedimentary matter metamorphosed into crystalline rock. That the original summits of the elevated ridge were domed or rounded seems altogether probable. That the summits are now no longer rounded is clear from the shapes of the shadows cast on the floor of the surrounding plane when the sun is rising in the lunar east. Here, then, is clear evidence of denuding action continuing long after the ridge had been, as it were, shouldered out of the seas by the side pressures of the sinking sea floors on either side.

On this occasion, then, or rather during this special stage of the moon's history, the denuding processes went on long enough, and with sufficient energy, to do such work as took place many times over during the past history of our earth. "The hills are shadows, our poet sings, and they flow from form to form and nothing stands; like mists they melt, the solid lands, like clouds they shape themselves and go." On the moon a poet would hardly have used such a comparison, even if any poet on the moon ever came to know so much of the past of his world as we have just indicated. For unquestionably the lands on the moon did not melt away like mists, but once only gave enough of their substance up to form one set of mountain ranges. The lunar poet could not echo the terrene poet's exclamation, "Oh earth, what changes hast thou seen;" once, and once only, he would have to admit, "hast thou, oh moon, seen change." Yet for the rest he might have sung (millions of years ago) with the Tennyson of our later world, "There rolls the deep where grew the tree; there where the loud street roars" (if ever they had loud streets in lunar cities), "hath been the stillness of the central sea."

But even of one such change the traces should remain.

* We use the words "east" and "west" the reverse way from that employed in lunar maps. Picturing the moon as a planet, and comparing the processes taking place on her surface with those taking place on the earth, it seems reasonable to speak of east and west on the moon as we speak of them on the earth, not (as our maps of the moon do) as we speak of them on the skies—for example, in speaking of a constellation.

If the floors of the great seas around the Lunar Apennines have been covered with matter washed from the lunar continents, we may look for the signs on those floors, now that the great deep has retired from them (to deeper depths), for traces of the continents over which the waves of those seas once rolled. Such signs, though they have been little noticed, are clearly to be seen. There are the ghosts of great craters—craters which once stood out above the continental tracts to which they belonged, but have now been silted over until, like the forms of objects buried beneath a deep and level snowdrift, they show only through some slight difference in the texture of the sediment lying over the raised parts of the hidden surface. These buried craters were as large as any still outstanding. They tell us of stages of the moon's vulcanian life earlier than those of which the immense extant craters speak. And even these, the mighty Tycho, 54 miles across and 12,000 feet deep, Copernicus, 58 miles across, Kepler, Archimedes, Plato—these speak of a stage of vulcanian activity such as once existed on the earth, but of whose progress the material records were destroyed millions of years ago.

EVOLUTION OF LANGUAGE.

By Ada S. Ballin.

V.—FAMILIES: THEIR DIFFERENCES AND SIMILARITIES.

In concluding my last article, I spoke of the slow growth of language as being due to the slow development of mind and acquirement of new ideas. In its early history the progress of language must, however, have been infinitely slower than at any later period, and its progress may be compared to that of a stone falling down a well with an accelerating velocity, which is trebled in the second second, multiplied by five in the third, by seven in the fourth, and so on; for, as I have already shown, the growth of language is primarily dependent on that of ideas, while, on the other hand, ideas are mainly developed by the use of language. Hence it becomes easy to understand how tardy was the early development of ideas when we consider the probably very imperfect language of primitive man. The human contemporaries of the great mammoths whose remains are found in the Post-Tertiary Drift, the men of the bone-caves, of the shell-heaps, of the peat-bogs, and those of the cromlech periods and early lake dwellings, must have lived for untold ages in far greater barbarism than any that can come beneath our ken. Progress must have crept on through the centuries, though with gradually increasing velocity, but tending always to a more coherent communal life, and consequently to an increased need of the means of communication. One of our greatest thinkers has said:—"There cannot be moral relations apart from society. . . . The intellect and the conscience are social functions. . . . The language we think in and the conceptions we employ, the attitudes of our minds and the means of investigation, are social products determined by the activities of the collective life. . . . We breathe the social air: since what we think greatly depends upon what others have thought,"* and the most important product of communal life, the means by which man influences and is influenced by man, the very basis of society, is language. The gregarious nature of mankind renders it an imperative necessity, and wherever primitive men may have herded together, in however small numbers, there language, whether of signs or sounds, most probably both, must have sprung up—crude and limited though it may have been, the earliest manifestation of the great organ of civilisation was then called into existence.

* G. H. Lewes's "Problems of Life and Mind," vol. i. p. 173.

"Language," says Professor Sayce,* "was not created until the several types of race had been fully fixed and determined. The Xanthocroid and the Melanocroid, the white Albino, and the American Copperskin existed with their features already fixed and enduring before the first community evolved the infantile language of mankind," but this seems open to the objection that it is too much to assume, for, as I have shown, gregarious animals have means of communication, and it would be unreasonable to maintain that the earliest men were not on a higher level than their four-footed contemporaries.

There are many theories to account for the largely different forms of language used by different races, and as many theories to account for certain similarities among them. In the first place, the differences have been quoted by some writers to prove the distinct origin of races, while others attributed the wide differences to phonetic changes and to the early separation of the human family. In the second place, the similarities can be accounted for either as evidence of the common origin of races or simply as a result of the similarity of physiological construction, especially of the vocal organs which permit of imitation of those sounds of nature which are common to all time and locality. Take, for example, the sound of the wind among leaves, running water, the crackling, roaring, and hissing sounds of burning materials, as well as the noises of animals and birds, and many others. From this it follows that languages would not necessarily be more varied than at present if each family into which we classify them had been derived from different original parents, and there is every reason to suppose that, as Sayce observes in another place, "the primitive languages of the earth were as infinitely numerous as the communities that produced them." But numberless communities have grown up and perished and left not a wrack behind, and it must have been the same with languages. Not only have languages perished with the speakers, but they have also been supplanted by conquering tongues, and, in a manner, killed at the sword's point. Not many years have passed since the last Tasmanian died, and with him the four Tasmanian dialects which our colonists found on their arrival became extinct; but, although the Welsh and the Irish peoples are alive and vigorous, their languages are dying out, supplanted by the English tongue.

Languages are classed in different families according as they can be traced to the same stock. Thus we say that English, French, German, and Hindustani all belong to the Indo-European family, although to different branches of the same; that Hebrew, Chaldee, Arabic, are sister-tongues, for they bear evidence of the strongest possible family relationship. But there are languages which, to continue the metaphor, are orphans and the only survivors of whole families, large or small, that have become extinct. Such are Etruscan, Basque, and the isolated languages of the Caucasus that seem to have no relations or friends in the world.

According to Friedrich Müller there are about a hundred different families of languages in existence between which no relationship has been established, although countless efforts have been made in this direction; and Sayce gives

* "Introduction to the Science of Language," vol. ii. p. 318.

a list of seventy-six families in which due attention is paid to collateral branches.*

Comparisons between various languages have been made times out of number for the purpose of proving them to be related, which have been based on a resemblance of sound. Thus, it has been argued, English and French are derived from Hebrew, because the word to *cut*, French *couteau*, a *knife* or *cutting* instrument, are akin to the Semitic forms, *katsats, khatsats, ka'sa's, gazaz, gazah, gazam, gaza', gazal, gazar, khadad, gadad, kada l, gadah, khatsah, katsa', katsar, ca'sakh, ca'sam*, which all give the idea of cutting; and similar fallacies have for centuries been popular; but, as I have already shown, this would prove only the imitative power of mankind, and does not of necessity prove any common origin. Scientific philology, a product of quite recent times, has, however, revealed the fact that most essential differences exist between those great families of language of which we have knowledge, and very striking results have been obtained especially with regard to the so-called Aryan or Indo-European and Semitic groups.

The Chinese language, belonging to the Turanian family, is, for a cultivated tongue, perhaps the most ideally primitive with which we are acquainted. Chinese civilisation and literature are among the oldest, if not *the* oldest, in existence; some of the odes of the Shiking dating as far back as 2000 B.C., and they presuppose many centuries of culture. The age of a language may be gauged by the extent to which it has been affected by phonetic decay, and Chinese, especially in the Mandarin dialect, shows many signs of this. Owing to this decay, words formerly distinct come to assume the same form. This happened in Chinese, and in order to distinguish between the different meanings of the same words, tones were introduced, that is to say words were pronounced with a different inflection of the voice in their various senses. There are now eight tones, but only four are in common use. I cannot tell Edkins's authority for making the statement, but if, as he says, it takes about twelve hundred years to produce a new tone, the fact of the existence of no less than eight says much for the antiquity of the language. The Chinese language possesses only about 500 words without reckoning these *tones*, the addition of which, giving different meanings to the same words, raises the number of word-meanings to 1,500. Chinese words represent ideas in undefined forms and are equally convertible into verb, adverb, or noun: thus *ta* contains the radical idea of greatness, being great, and may be used as a substantive, *greatness*; verb *to be great* or *make great, magnify*; and as an adverb, *greatly*; the meaning in which it is used being apparent from the context and partly by its position in the sentence. It seems reasonable to suppose from what we have seen of the sign language of the deaf and dumb, in which there is no possibility of inflectional changes, and of the use of gestures by savages, to mark and supplement their application of words, that the earliest use of vocal signs or words was thus undefined. We have seen that phonetic variations of a single word may produce hundreds of other words varying in their construction according to the genius of the peoples who use them, and we can, therefore, suppose some such an ideal root word as we meet with in Chinese remaining unchanged among so conservative a nation as the Chinese, taking a verbal form among Aryans and a nominal form among the Semites. Whitney maintains†: "That the first traceable linguistic entities are not names of concrete objects, but designate actions, motions, phenoomnal conditions, is a truth resting on authority that overrides all preconceived theories and subjective opinions," and from what we have already learnt about the natural development of language, the growth of the various parts of speech from such an original form can be readily conceived. The first words would be representations of sensations. "Miaou," the cat, as in Chinese and ancient Egyptian, is the animal heard to produce that sound. *Pat*, the Aryan root significant of flying, is a representation of the sound of wings in motion. To take a modern parallel, our word *green*, literally *growing*, is used as a noun, *greens* meaning *green vegetables*, and in dumb language *grass* is what "grows up from the ground," and the sign of moving the hand gradually up from the ground also signifies *green*.

Long years of patient research have brought philologists to the conclusion that the origin of all Indo-European languages may be found in a certain limited number of roots whence the various words were derived. These roots are monosyllabic, and may be compared to the monosyllabic words of which the Chinese language is composed, and, although they are never found at present in the form which by careful analysis has been assigned to them, it is thought that the ancestors of Indo-European races conversed in single syllables indicating important ideas, but not as yet showing their mutual relations.* These roots are divided into two classes: I. Those signifying position—demonstrative or pronominal roots; II. Those signifying action or quality—predicative or verbal roots.

From the first and smaller class come the demonstrative and personal pronouns, the interrogatives, the possessives, and relatives, and other less important classes, as also adverbs of position and direction. Those beginning with *m* are especially used to denote the subject, those with *t* and *n* more demonstratively, and those with *k* for interrogation. There are but few of them, hardly more than a dozen, including some which are probably themselves derived from one original. They are very simple, consisting either of a single vowel, such as *a* or *i*, or of one consonant followed by an open vowel, as *ma, na, ta, tu, ka*.

The other class is very large and shows every variety of the syllable; the roots imply properties and activities presented in natural objects: visible phenomena, motions, and sounds. The following are some such roots shown to have belonged to the original stock, as they are found in most, if not all, Indo-European tongues, *i* and *ga* indicating motion; *ak*, swift motion; *stā*, standing; *ās* and *sad*, sitting; *kī*, lying; *pad*, walking; *vas*, staying; *sarp*, creeping; *pat*, flying; *plu*, flowing; *ad*, eating; *an*, blowing; *klu*, hearing; *dhā*, putting; *dā*, giving; *dik*, pointing out; *tan*, stretching; *skid* and *dal*, cutting; *mar*, rubbing.

Polysyllables seem to have originated in the combination of roots of these two classes for the purpose of defining some idea, as *va.lmi*, I here eat; *adsi*, thou there eatest; *ma-si*, *I* plus *thou*, equals *we*. Repetition of the root or reduplication was made to represent the completion of the action indicated, as Sans. *dadān*, given, from the root *da*, give, and so on, every new form by analogy becoming the source of a hundred others. It is thus that words signifying different ideas are compounded to represent some idea which embraces both. In the course of time these combinations with the ideas they represent become fixed in the mind, and their origin is obscured or forgotten; then by the process of phonetic decay they may become reduced to apparently simple forms. Thus in English the words to *don* and to *doff* are from earlier forms to *do on* and to *do off*. Our word *vend* is from the Latin *venum dare*, our *blame* from the Greek *blas-phēmein*, and so on.

* See "Introduction to the Science of Language," 1880, vol. ii. pp. 33–64.

† "Language and the Study of Language," ed. 1810, pp. 260-1.

* See Whitney's "Language and the Study of Language," p. 257, *et seq.*

MEN AND APES.

THERE is a way of speaking of the relationship recognised by science as existing between men and apes which requires correction, as tending to encourage a very prevalent but quite incorrect notion respecting the doctrine of descent. By many this doctrine is understood to imply that man is descended from a race of beings identical with some order of monkeys existing in our own day, or at least closely resembling one of these orders. The doctrine of descent does not involve any such teaching, while that special form of the doctrine which is called Darwinism is very strongly opposed to it, because natural selection implies slow development. (The views advanced by Mivart *might* account for the appearance of man as a descendant of some order of apes, because admitting change *per saltum*, and also the actual copying of an old order, in one or more respects, by a new order; but in his "Man and Apes" he certainly does not encourage the opinion that man descended directly from an order of apes resembling any at present existing. Nor does he anywhere indicate, so far as I know, his actual opinion as to the origin of man.)

It does not appear to be commonly recognised that, according to any doctrine of descent not admitting both of change *per saltum*, and of the reappearance of old forms *otherwise* than by reversion (as though nature had certain types, which at any time might be introduced in lines of descent where heretofore they had not been known), no order existing in the present time can be regarded as closely resembling the progenitors of man at a remote era. For, if this were the case, then on the downward line from those progenitors to man there must have been great change by development, while on the downward line from those progenitors to the order imagined there has been by the supposition scarcely any change. But it is incredible that during the enormous interval necessary to develop man from progenitors resembling any present race other than man, another line of descent from those same progenitors should have remained without noteworthy change. This is true, whether we consider the highest orders of the true apes, or some race which, according to the doctrine of descent, is far more remotely related to man. The general conditions involved may be thus presented:—

At any remote time, T years ago, when man had not as yet appeared, let a class including every individual whose blood has *descended* to the existing races of man be called A_1, and let the classes similarly related to other existing orders *sharing* descent from A_1, be called A_2, A_3, A_4, &c., to A_n. Then, by the supposition, class A_1 more or less overlaps each of the other $(n-1)$ classes; but the mistake is commonly made of supposing that either the n classes A_1, A_2, A_3, &c. were identical, or that at least class A_1 included *the whole* of the remaining $(n-1)$ classes and *no more*. And from this mistake arise most of the commonplace and superficial objections to the doctrine of descent. According to the real teachings of that doctrine, while A_1 overlaps each of the remaining $(n-1)$ classes, it must have had a portion not included in any one of these, while any one of the set of classes may have overlapped some of the others, but not all, besides overlapping other classes outside the series, and having also a portion distinct from all other classes. The greater T, of course, the greater would n be.*

The mistake commonly made may be further illustrated by considering ordinary relationships. If I ascertain that a certain family (X) is related to my own, I do not infer that a certain number of generations ago my family were all X's, or that from the X family there may be bred, in a certain number of generations, descendants closely resembling my own family in all its characteristics, bodily, mental, and moral. Again, no one supposes that Malays, Negroes, Esquimaux, or any other race, could, in any length of time, develop into a race closely resembling the Caucasian, though it may be admitted that some inferior races of men may be gradually raised by development to the intellectual level of races at present superior to them. So far from approximating to the superior race in this process (except as to level, supposing the superior race stationary in that respect), the races would probably diverge, for divergence is the rule and approach the exception.

I may add, what is commonly overlooked in speaking of descent, that the farther back we go the greater is the number of progenitors, whether individual ancestors or ancestral races be considered. At any rate, this is true within the limits of ordinary biological research. Nor is the rule in the least affected by the circumstance that a family or race may for a time avoid alliance with individuals outside the family. Supposing even such avoidance perfect, we have only to go to the beginning of the family, as such, to find the law of increase resumed as we pass farther back.

Individual teachers of the doctrine of descent may believe in a small number of primordial forms, and, of course, it is theoretically possible that, as we pass backwards, after reaching a certain maximum in the number of forms, the number would diminish until only a few remained, from which all the present forms have descended. But science

---

* The case here considered, which is in reality exceedingly complex, may be conveniently illustrated by a simple imagined case:—Let T represent three generations, and consider one family—say, a brother and sister—as corresponding to the race of man in the above case. Suppose there has been no intermarrying in the three preceding generations, so that the pair had four great-grandfathers and four great-grandmothers—in all, eight persons corresponding to class A_1. Now, suppose every couple in the ancestry to have had two children, son and daughter, each of these to have married and had two children, this happening on all lines downwards from A_1. Then it will be found that the pair has ten families of cousins, two first-cousin families, and eight second-cousin families; and these are all the families which share *descent* from the eight great-grandparents of the pair (to pass to third-cousin families we should have to ascend to the fourth generation). Thus there are eleven families in all. Now, if we suppose the eight great-grandfathers, or class A_1, to be all wealthy, or noble, or handsome, or in some respect luckier than the remaining ancestry of the eleven families, then the pair will presumably possess similar superiority. Say they inherit greater wealth, so that the other ten families are of the order of "poor relations," and so, of course, may serve to illustrate the ape tribes—our poor relations among the vertebrates. Now, if the eleven families were in no way connected, it is clear they would have eighty-eight ancestors in all at time T, or in the third generation of ancestors. But it will be found that, being related, as above supposed, they have instead only fifty-six. The two first-cousin families (corresponding, say, to the higher apes) have each eight ancestors, forming classes A_2 and A_3, A_2 not overlapping A_3, but A_1 overlapping, by one-half, both A_2 and A_3. The remaining eight families (corresponding, say, to the lower apes) have each eight ancestors forming classes A_4, A_5, . . . A_{10}, A_{11}; and A_1 overlaps one-fourth of each of these classes. It may be noted in passing that we should find in such a case that, though the two first-cousin families might, on the whole, resemble the favoured pair more closely than the other eight would, there would be some circumstances in which the second-cousin families showed closer resemblance—just as Mivart shows that in some features this or that order of the lower apes resembles man more closely than either the gorilla, the orang, or the chimpanzee. I must confess I cannot recognise the force which Mivart finds in this circumstance as an argument against the doctrine of development by natural selection. It is, of course, precisely what we should expect, according to the general doctrine of evolution, which Mivart appears to accept; but it seems to me to make neither for nor against the special doctrines of the Darwinian theory, when due account is taken of the increasing number of relations as well in ascent as in descent.

has given no evidence in favour of the doctrine that all existent forms so descended, any more than it has given evidence in favour of the doctrine that the whole human race was once represented by two persons. Many believers in the doctrine of descent consider that when life first began on this globe (whether at an epoch or during an era) forms as multitudinous and varied as those now existing made their appearance on the earth. Be this, however, as it may, it is certain that, during the enormous periods over which palæontology ranges, there has not only been no modification from more to less generalised types, but that, as Professor Huxley long since stated, "an impartial survey of the positively ascertained truths of palæontology negatives that doctrine."

INCOMBUSTIBLE THEATRES.

By Henry J. Slack.

It is strange that theatres continue to be built so as practically to insure their being burnt down before they have been in existence many years, whereas it is quite possible, not to say easy, to render such accidents very improbable. It may be conceded that a theatre will be sure to have in its stage and property departments a considerable quantity of materials easily ignited, and sure to blaze. Even this *might* be prevented, but complete prevention would be too troublesome, and perhaps also too expensive. What ought to be done is to ensure that a blazing up of the readily combustible matter should not be able to ignite the main structure, or any large part of it. All the recent theatrical fires have shown that the arrangements, where any exist, intended to secure this object, fail, and so they will do until wiser principles of construction are acted upon. The spectators' part of the theatre, the auditorium, with its entrances, stairs, passages, &c., ought not to contain any matter that is inflammable, or easily combustible, even if attacked by a large body of flame arising from gas escape, or fiery outburst on the stage or property part. Brick, or stone and iron, should constitute the framework, and where wood could not be conveniently dispensed with, it should be prepared under hydraulic pressure with tungstate of soda, or some such substance, and covered with an incombustible paint. All hangings and seat-covers should be impregnated with the tungstate. The seats should be made soft, with steel springs, or stuffed with the fibrous material made out of iron slag, and known as silica cotton. So far as possible, the stage properties and appliances should be fireproofed upon these principles. At the worst, what would then happen would be a fire that could not, as now, rage in a few minutes to utterly hopeless proportions. In most cases of theatre destruction the gain of a little time would have enabled the building to be saved. With an auditorium constructed as suggested, its materials could not be quickly raised to anything more than a dull, smouldering state, even if a conflagration in the stage part were not soon cut off from it by descent of an iron curtain. All floors, except the stage, might be made of iron and cement, and wood entirely banished from the greater part of the building.

The cost of such a construction might be more than the price of a theatre calculated to perish in less than twenty years of ordinary risk, but it could be insured at a much lower rate, especially if supplied with plenty of pipes containing one of the anti-conflagration fluids, which would be let out as soon as a fire raised plugs of a fusible metal within a few degrees of the boiling-water point. No building can come near the condition denominated fireproof if any large portion of it contains so much readily inflammable matter that within a few minutes of ignition it is converted into a fiery furnace with heat enough to twist iron and crack stone. It surely is not essential to a theatre to be in this condition. The property part is, of course, the most dangerous, but even there steel could replace wood for all framework and supports, and, where space is not so valuable as to prevent it, stores of all kinds should be in a separate building; if not, divided from the other parts by a party-wall.

COMPOSITE PORTRAITS.

The four accompanying pictures are good illustrations of the method of composite portraiture, advocated long since by Mr. Francis Galton. They were taken last year in America, at the suggestion of Messrs. Brewer & Pumpelly, and are among the earliest American successes in this method.

The object of the method is to portray types, excluding individual peculiarities. Mr. Galton has pointed out that in travelling through a country, peopled by an alien race, the voyager seems to recognise a general similarity among the persons whom he meets, because he is struck by the general characteristics—novel to him—of the race; and so gives less attention to peculiarities affecting individuals than he would were he among faces more familiar. In a similar way, the resemblance which a stranger finds among the members of the same family is explained. Those who being of that family do not much notice its general type recognise the differences which really exist much more clearly, and wonder that any one can see resemblance where they see such obvious distinctions. Composite pictures, in like manner, bring out the characteristics which are common to a race or family, and hide those which are exceptional.

In *Science*, an American paper, from which the accompanying pictures were taken, the following particulars of the construction of the pictures are supplied by Mr. Pumpelly:—

"The individuals entering into these composites were all photographed in the same position. Two points were marked on the ground glass of the camera; and the instrument was moved at each sitting to make the eyes of the sitter exactly coincident with these points. The composites were made by my assistant, Mr. B. T. Putnam, who introduced the negatives successfully into an apparatus carefully constructed by himself, and essentially like that designed by Mr. Galton, where they were photographed by transmitted light. The arrangements of the conditions of light, &c. were such that an aggregate exposure of sixty-two seconds would be sufficient to take a good picture.

"What was wanted, however, was not an impression of one portrait on the plate, but of all the thirty-one; and to do this required that the aggregate exposure of all the thirty-one should be sixty-two seconds, or only two seconds for each. Now, an exposure of two seconds is, under the adopted conditions, too short to produce a perceptible effect. It results from this, that only those features or lines that are common to all are perfectly given, and that what is common to a small number is only faintly given, while individualities are imperceptible. The greater the physical resemblances among the individuals, the better will be the composites. A composite of a family or of near relatives, where there is an underlying sameness of features, gives a very sharp and individual-looking picture.

"It would be difficult to find thirty-one intelligent men more diverse among themselves as regards facial likeness

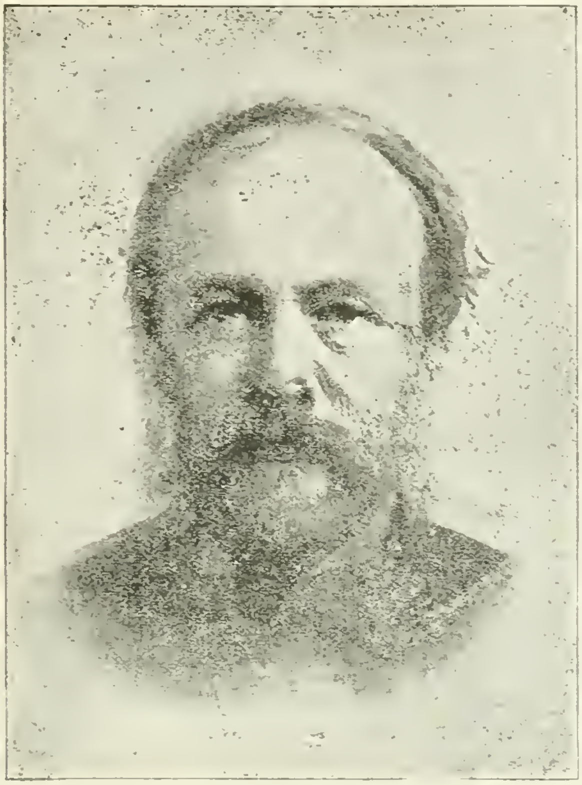


Fig. 1.—Twelve Mathematicians.

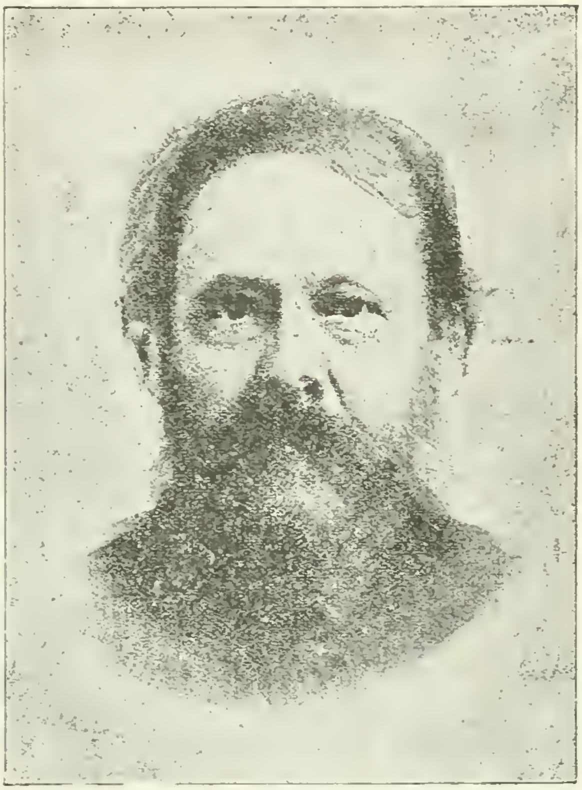


Fig. 2.—Sixteen Naturalists.

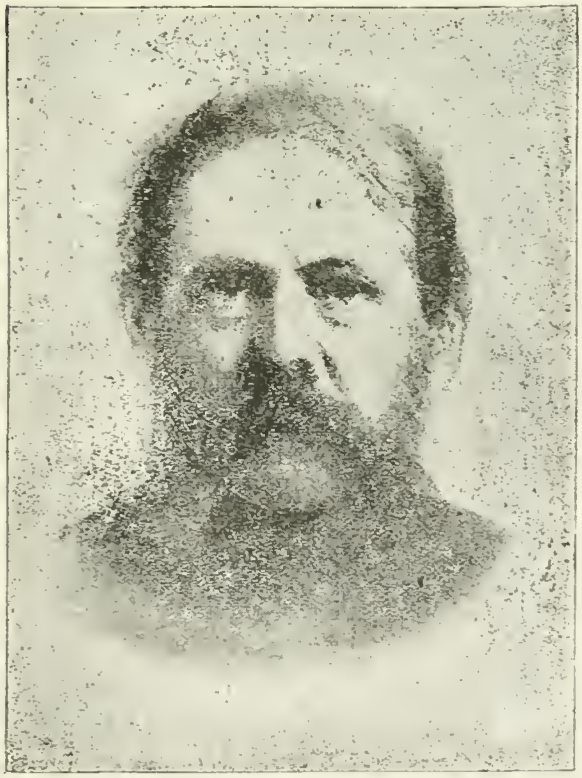


Fig. 3.—Thirty-one Academicians.

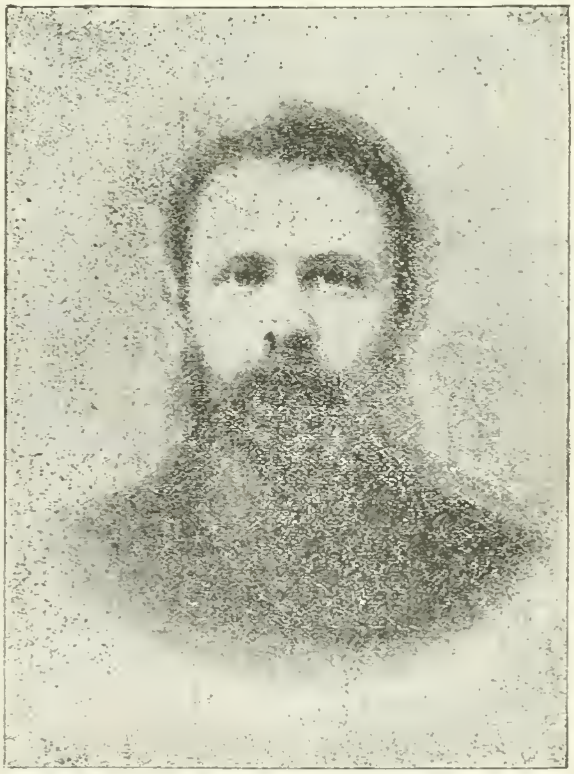


Fig. 4.—Twenty-six Field-Geologists, Topographers, &c.

COMPOSITE PORTRAITS OF AMERICAN SCIENTIFIC MEN

than the academicians entering into this composite. They are a group selected as a type of the higher American intelligence in the field of abstract science, all but one or two being of American birth, and nearly all being of American ancestry for several generations. The faces give to me an idea of perfect equilibrium, of marked intelligence, and, what must be inseparable from the latter in a scientific investigator, of imaginativeness. The expression of absolute repose is doubtless due to the complete neutrality of the portraits.

"Fig. 3 contains eighteen naturalists and thirteen mathematicians, whose average age is about 52 years. Fig. 1 contains twelve mathematicians, including both astronomers and physicists, whose average age is about $51\frac{2}{3}$ years. Fig. 2 is a composite of sixteen naturalists, including seven biologists, three chemists, and six geologists, with an average age of about $52\frac{1}{3}$ years.

"I may mention, as perhaps only a remarkable coincidence, that the positives of the mathematicians, and also of the thirty-one academicians, suggested to me at once forcibly the face of a member of the Academy who belongs to a family of mathematicians, but who happened not to be among the sitters for the composite. In the prints this resemblance is less strong, but in these it was observed quite independently by many members of the Academy. So, also, in the positive of the naturalists, the face suggested, also quite independently to myself and many others, was that of a very eminent naturalist, deceased several years before the sitting for this composite.

"There is given also a composite (fig. 4) of a differently selected group. It is of twenty six members of the corps of the northern transcontinental survey an organisation of which I had charge, and the object of which was an economic survey of the North-Western Territories. It was a corps of men carefully selected as thoroughly trained in their respective departments of applied geology, topography, and chemistry, and having the physique and energy, as well as intelligence, needed to execute such a task in face of many obstacles. The average age of this group was 30 years."

DRAWING ELLIPSES.

THERE are many ways of drawing ellipses, from the wretched way commonly described as a good way (the string-and-pin method) to very complicated though very exact methods. Perhaps there is no way much simpler than that illustrated in the figure on page 291 (fig. 1). It needs no explanation. Two equal series of equidistant circles are described around each focus, and the intersections of the successive circles (taken increasingly) of one set, with the successive circles (taken decreasingly) of the other set, give an ellipse. To determine an ellipse having given foci, and a given minor axis, one has only to take that particular ellipse, of several given by the construction, which passes through the ends of the desired minor axis. (Or the major axis, if we prefer it, may be used to determine the ellipse.) Of course, it is quite easy to take the radii of our circles so that two equal circles around the foci shall intersect at extremities of any indicated minor axis, or, if we prefer it, two circles around the foci may intersect at any desired distance from either focus to determine an end of the major axis: after that taking equal divisions along the major axis, produced if necessary, we get all other radii. Fig. 2 illustrates a similar method for drawing any desired hyperbola.

Reviews.

Natural Causes and Supernatural Seemings. By HENRY MAUDSLEY, M.D. (London: Kegan Paul, Trench, & Co. 1886.) Dr. Maudsley remarks that "a really new reflection is probably as rare and doubtful an event as a new virtue, or a new vice, or a new disease." But if, in agreement with this, we abstain from speaking of his book as original, we may none the less assess it as one of the wisest and most thoughtful books of our time, and not unneeded. Its object is to examine how far the great mass of supernatural beliefs which have persisted from the lower culture till now, and which are still held by an overwhelming majority of civilised mankind, are referable to causes which were concomitant with man's mental development, and are operative still. For in the degree that these beliefs are brought under the law of causation—in other words, accounted for—they are removed from the ever-contracting area of the unexplained, and divested of their artificial importance. Dr. Maudsley submits these "seemings" to scientific inquiry, seeking for the modes of their origin and growth within the region of human experience, and narrowing them within the sphere of medical psychology. Discarding theories of revelation, spiritual illumination, and other assumed supermundane sources of knowledge, the author finds sufficing causes in the operations of the mind both in health and disease. In the one there is the defective and false reasoning due to man's long uncorrected sense-perceptions, and to the uncurbed play of imagination; in the other there are the hallucinations, visions, epidemic delusions, and other abnormal states which are the product of bodily exhaustion and unsound mental action. Then there are the ecstatic conditions which in the lives of the saints and the confessions of morbid natures are referred to the direct action of the divine on the human, but which are really the product of spasmodic nervous action or of indigestion. As Hood says of such folks, "they think they're pious when they're only bilious." The earlier chapters furnish an interesting analysis, aided by apposite illustrations, of the causes of fallacious reasoning as to supernatural existences through coincidences due to apparent answers to prayer, to fulfilment of dreams, to good or ill luck on certain days, to distorted or false observations, and also through the innate tendency of the human mind to find a supernatural cause for whatever it cannot understand, as notably illustrated in the belief in witchcraft which, supported by the authority of the Old Testament and the reasoning of distinguished doctors and jurists, lingered amongst us far into the last century. From these the author passes to the use and misuse of the imagination. That which under wholesome restraint has been the incentive and initiative of progress, of enterprise, of inquiry, of noble ideals, has, unrestricted, led the enthusiast and the dreamer into the engulfing quicksands of theories. And Dr. Maudsley, therefore, looks forward to a time when this purposeless waste shall be stopped, and the imagination, abstaining from soaring where it vainly beats the air, shall gain a hundredfold in power and in service to man "in working soberly to definite ends within the domain of sense and thought." The general lesson of the book may be gathered from this extract:—

Not by standing out of nature in the ecstacy of a rapt and overstrained idealism of any sort, but by large and close and faithful converse with nature and human nature in all their moods, aspects, and relations, is the solid basis of fruitful ideals and the soundest mental development laid. The endeavour to stimulate and strain any mental function to an activity beyond the reach and need of a physical correlate in external nature, and to give it an independent value, is certainly an endeavour to go directly contrary to the sober and salutary method by which solid human development has taken place in the past, and is taking place in the present.

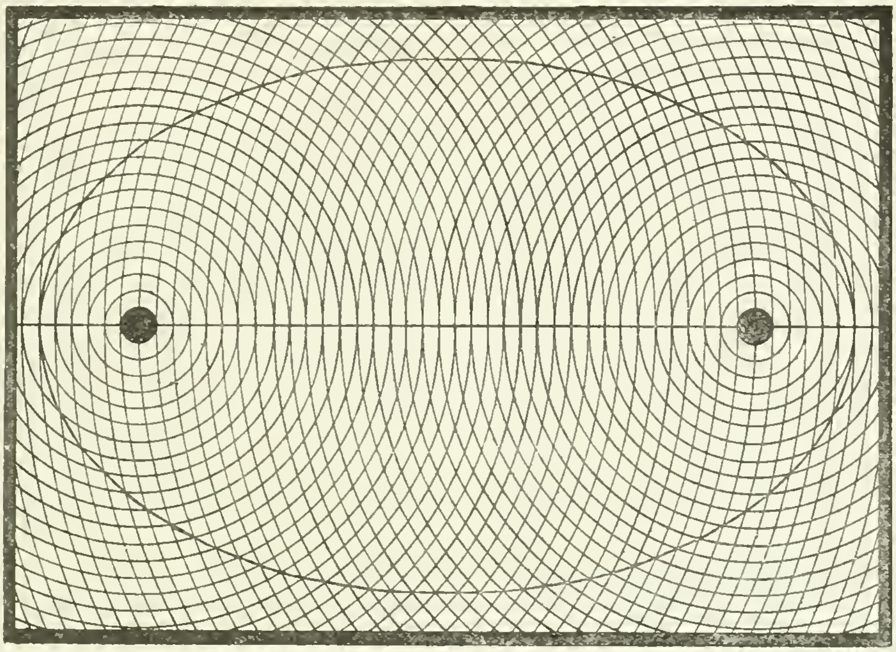


FIG. 1.—THE ELLIPSE.

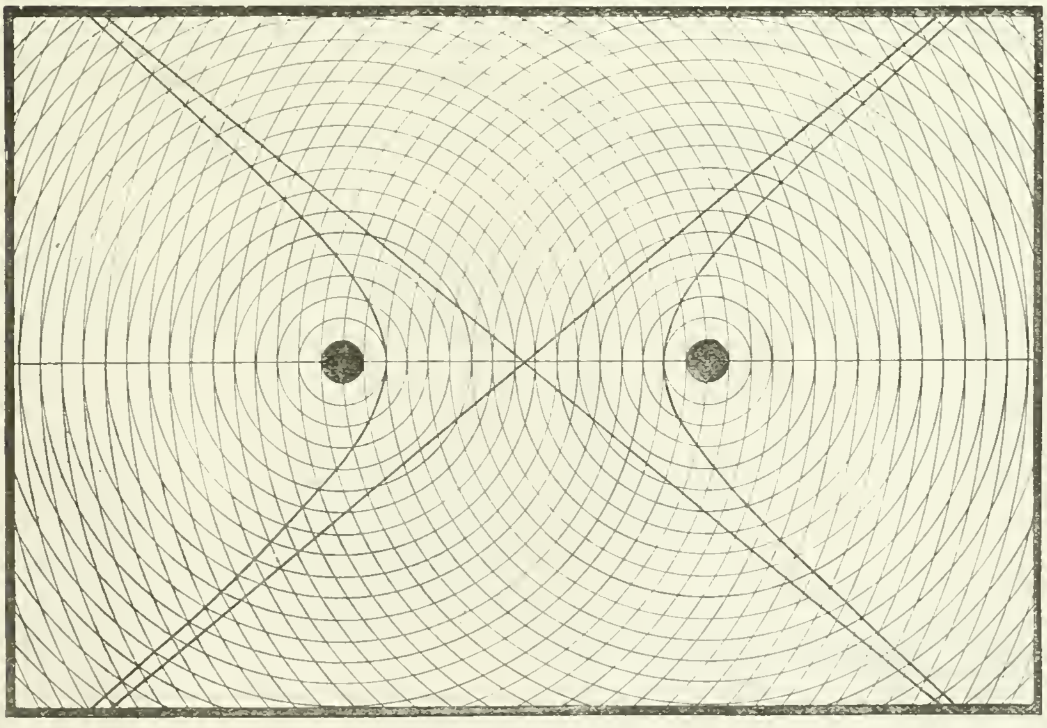


FIG. 2.—THE HYPERBOLA.

We can only hope that this able and eloquent book may fall into the hands of persons of yet undisciplined emotional temperament. They will find its teaching a wholesome corrective to illusions the dispelling of which will set free energies, now wasted over chimeras, to be utilised for fruitful aspirations and labours.

The Larger Life: Studies in Hinton's Ethics. By CAROLINE HADDON. (London: Kegan Paul, Trench, & Co. 1886.) It is probably known to most readers of KNOWLEDGE that James Hinton was an aural surgeon of eminent skill and of high repute. He was also a metaphysician of originality, as was shown by the volume he published more than thirty years ago, under the title of "Man and his Dwelling Place." His originality consisted in going a step beyond the idealism of Berkeley and others, and asking the question, Why do we see and feel the world to be other than it is? The answer to that question was drawn from a scrutiny of human nature, intellectual and moral, and resulted in the conclusion that this misconception was due to a defect in man himself, which was the cause of a false consciousness in him. The application of that theory to moral phenomena obviously leads to an ethical philosophy unlike those built upon the opposite and common assumption. Miss Haddon, in an earlier volume, selected passages from Hinton's unpublished writings explanatory and illustrative of his views on metaphysics, religion, and ethics, which was published under the title of "Philosophy and Religion." The present volume is devoted to his ethical doctrines only. Its contents are partly selected from Hinton's works and MSS., and are partly original. Of the former, by far the most valuable are selections from letters that passed between himself and Miss Haddon. The original papers treat of the Philosophy and Ethics of James Hinton; of Utilitarianism and Atheism; of Hinton the Seer; and concludes with a few notes on Hinton's Theology. To those who know James Hinton's writings, this book is helpful as increasing their knowledge of him; to those who do not know his writings it will prove a valuable introduction to a philosophy which was at once mystical and scientific.

The Western Pacific and New Guinea. By HUGH HASTINGS ROMILLY, Deputy Commissioner for the Western Pacific. (London: John Murray. 1886.)—This book is not the result of a scamper round the globe by a tourist who wanted to tell something, but of unhurried official journeys over the fifteen millions of square miles of land and ocean embraced under the term Western Pacific, by a shrewd and kindly observer who has something to tell, and who tells it in a modest fashion, all the more graphic and effective for the lack of any varnishing of his notes. Mr. Romilly shows himself a type of representatives abroad of whom his country may be proud. He does not regard the native races as a pack of doomed and "damned niggers," who ungratefully resent the introduction of civilisation and covenanted mercies, and he enlists our sympathies with their blood-feud against the scoundrelly white traders who have scourged them with smallpox and unnameable diseases, kidnapped them on board sham missionary ships, enraged them by their rapacity, and thus counteracted the work of the missionaries, to the value of which Mr. Romilly pays hearty acknowledgment. His remark that these whites have taught the natives "to swear in a truly marvellous manner" brings to mind a statement of Dr. Livingstone's that the only art the Africans had acquired from five centuries' acquaintance with the Portuguese had been to distil spirits from a gun-barrel, and the only belief the belief that man may sell his fellow-man. Mr. Romilly saw much that is novel, both of the amusing and the terrible, in his wanderings; there is not a dull page in his book, and we close it asking, like Oliver Twist, for more, especially where hints are given of manners and customs which he indicates cannot be described in detail. How the ship's doctor astonished the natives of Solomon Islands by dexterously twisting out his false teeth, while the old chief Takki uttered thankfully a *Nunc dimittis* that he had lived to see that day; how an ingenious visitor to Fiji escaped from the cannibals by unscrewing his cork leg: how Mr. Romilly's Samoan partner at a ball despoiled him of his studs, and well-nigh of the shirt that they adorned; above all, how he had the rare, if unenvied chance, of witnessing a cannibal banquet, the details of which are as revolting as they are valuable; with all else besides concerning the superstitions and ways of life of the Melanesians generally, our readers must learn for themselves. To the anthropologist this book is indispensable; and in commending it to a wider class as a book to be bought and not borrowed, we hope that its reception may encourage the author to a further record of his travels, and more especially of the social institutions and mythologies of the islanders, crude as these may be. The scantiness of information on these subjects, together with the absence of an index, are the only drawbacks to the present work.

Six Months in Cape Colony and Natal, and One Month in Teneriffe and Madeira. By J. J. AUBERTIN. (London: Kegan Paul, Trench & Co. 1886.)—This is a record of travel of a quite different order, in a quite different and far more familiar field. A pleasant, lightly-written, gossipy book, which people intending to visit, or rather, settle at, the Cape, should put in their trunks. There is useful information about the South African industries, diamond-seeking, ostrich-farming, wine-growing, in which last the colony has much to learn; but the author has inflicted on us too much tattle of detail. That he might have stayed another night at Forest Hall; that he signed his name in the visitors' book, and that he couldn't sleep, therefore got up at 1.30 A.M., may be interesting to his immediate circle, but they are not matters that the world very much wants to know. The political discussions in the book are happily outside the serener sphere of this Journal; but the author's judgment on the Majuba business (Amajuba, meaning "many pigeons," is the correct form, Mr. Aubertin tells us) may be compared with the different judgment pronounced upon it by Mr. Froude in "Oceana." A few excellent woodcuts from photographs illustrate the text.

How to Form a Library. By H. B. WHEATLEY, F.S.A. (London: Elliot Stock. 1886.)—In this compendious and choicely-printed book one of our most accomplished bibliophiles gives the result of much mixing with his class and their possessions. The work will be found especially serviceable in the formation of public libraries, a useful feature in it being a fairly full list of books of reference, in which, by the way, under "Astronomy" Miss Clerke's recent History should be substituted for Prof. Grant's, that being out of print. We are glad to find Mr. Wheatley opposed to the "best hundred books" silly craze, for, given a few general directions, the attempt to control taste in any uniform fashion can only end in inducing mental dyspepsia. To know something of everything and everything of something was an aphorism of John Stuart Mill's that we do well to act upon; as well as to remember

> No profit grows where is no pleasure ta'en:
> In brief, sir, study what you most affect.

The Voice: Musically and Medically Considered. By ARMAND SEMPLE, Physician to the Royal Society of Musicians. (Bailliere, Tindall, & Co.)—A useful and practical recast of articles from the *Musical Standard*, the interest of which is not limited to singers, but extends to all persons subject to throat-weaknesses.

Gossip.

By Richard A. Proctor.

The article on the nebulæ in the Pleiades has been postponed till next month, owing to some delay in obtaining one of the necessary pictures.

* * *

In Munich on May 12 there was observed, in the early morning, a phenomenon which excited terrible alarm among the foolish. Heavy rain had fallen all night, and this rain had clearly brought down a quantity of sulphur. For, all round the pools and streams of standing or running water in the streets were streaks of yellow mud, of the primrose tint proper to the substance which Satan claims peculiarly as his own. The old women of both sexes, with their accustomed brilliancy, recognised the approaching end of the world in this terrible phenomenon. After smelling at the yellow mud, and finding that there was clear evidence of the devil's favourite odour, they remembered that the end of the world had been specially announced for the year 1886—for the exquisite reasons that Easter day falls later this year than it has for more than a century, and that the year both begins and ends with a Friday. A portentous number of Fridays—positively fifty-three, instead of the usual fifty-two!—a late Easter, and a fall of devil's dust ought to bring about the end of the world, at least when four comets are about and the giant planets have recently passed their perihelia, while the great pyramid has already told us of the end of all things for four years (June 1882 marked, at any rate, the end of the Christian dispensation, according to the Pyramidalists).

* * *

But, alas! there are always disappointments. Did not the comet of 1882 threaten the world's end and then go off for a thousand years or more? Did not the year 1000 pass without the world's end, naturally due then (for the devil can count up to a thousand, it seems), being brought to pass? Nay, unless the writers of the gospels, whoever they may have been, were very much deceived, very high authorities, including one who should have been the very highest, were well assured that the world's end was coming eighteen hundred years ago: yet it omitted to arrive.

* * *

And so it was this time, so far as the promise of the sulphur dust was concerned; for it changed itself into something quite different. Indeed, those wretched sceptics the students of science asserted that it never had been sulphur at all, but was simply the pollen of the fir, which this year has been so great in quantity that every wind has swept clouds of it from the great fir forests of South Germany.

* * *

It is too bad for the evil one thus to deceive those who put their trust in him and expect a sulphurous end shortly for this world. Perhaps it is because he has been a liar from the beginning, as—according to John viii. 44—was also his father before him. (Though, somehow, even the revisers have not been bold enough to translate that verse correctly which teaches that Satan had a father: of his mother our familiar sayings about "the devil and his dam" have long since taught us.)

* * *

I am inclined to suggest that vegetable dust in the air may perhaps explain the cold spells in April and May better than meteor dust. But if meteor dust at all is in question, most assuredly it is not in the wildly impossible way suggested recently in *Nature*. The editor of *Nature* has allowed his well-known dislike and contempt for mathematics to carry him too far in admitting such nonsense. Multiplication may be vexation (many fathers find it so), and division as bad (as divided households show): the rule of three (divine or otherwise) may puzzling be, and practice (as of some professing Christians) make us sad; *but* we must not multiply two by two and get five for the product.

* * *

It becomes depressing in Germany to see every day and every hour the signs of military life, and to think of what those signs really mean. The pride, pomp, and circumstance of glorious war are all very well on special occasions, though even those more splendid adjuncts of military relations become wearisome after awhile, and are always essentially unpleasing to the philosophic mind, as being a trifle too strongly suggestive of barbaric ancestry. But in military countries one sees much more of the dreary drudgery of military training and warlike preparation than of anything particularly splendid. To see this day after day, to remember that about two millions of men are always engaged thus meanly throughout Europe, and to consider what all this really means, is to be very strongly moved by the thought that "we men are a little race."

* * *

That which most men—and the human race must be judged by the majority, whatever the minority of the wiser sort might wish—that which most men regard as the finest of all the fine things men may do, is merely a gaudy remnant of savagery. The fighting qualities of mankind have been developed primarily in direct connection with plunder on an ever-growing, and therefore ever more degrading, scale. And though now the secondary relations of our fighting qualities—their defensive as compared with their offensive applications—are more considered than they used to be, yet no one can read the expressions of opinion in Continental newspapers, at any time, without feeling that the first object of all European armaments is defiance, not defence. The peoples have been so long employed by the rulers to fight for territory—to seize territory from others, and to retain it when seized—that they have inherited the imperial instinct (that is, the love of plunder and oppression), and rejoice as much in their degradation as the average monarch in grasping that which is not his own.

* * *

"Mr. Grant Allen, in his Shilling Shocking 'Kalee's Shrine'—a very striking story, by the way—has done good service in drawing attention to the dangers of what is commonly called mesmerism. He steers the true course between the folly of those who recognise the supernatural in mesmeric phenomena, and the unwisdom of those who reject those phenomena altogether. While thus helping to remove the unwholesome attraction which mesmerism, in being mysterious, possesses for weak minds, Mr. Allen effectively shows also that the effects of the perfectly natural processes by which the hypnotic condition is produced may be most mischievous.

* * *

"This may happen in two ways, on one only of which Mr. Allen insists in his story. The worst effect of mesmerism is found in a weakening of the mind brought by stupefying influence under the power of suggestions presented by another mind. There can be no doubt that a mind of average strength after being reduced many times to the hypnotic state is permanently weakened, will power is diminished, and what more serious loss can any man sustain? 'Oh, well for him whose will is strong,' says our Poet Laureate, and we all feel in our inmost hearts how

true the statement is. Happy for each one of us are those hours when our will is at its strongest. And were the truth known, the feeling we call repentance, the sorrow for wrong done or temptation not resisted, is largely due to the physical sense of weakened will. Submission, often repeated, to mesmeric influence, has as evil an effect as yielding again and again to temptations towards wrong-doing.

* * *

"On this weakening of the will Mr. Allen does not touch, or rather his story does not turn on this observed physiological fact. But the other form of mesmeric mischief is very serious also. A person mesmerised or put into the hypnotic state is like a somnambulist. In fact, there is nothing in reality more supernatural about hypnotism than there is about somnambulism. Now, we know that somnambulists often do very strange things. They are apt to be quite different in their modes of apparent thought, and most certainly in their actions, from what they are when in full possession of their senses. The story of the somnambulist who buried suit after suit of his own clothes —and also of clothes he had borrowed—see the "Ingoldsby Legends"—is based on facts. So also are stories of somnambulists who have offended much more seriously, nay, of some who have not stopped short of murder. Now, when a mesmerist, having put his victim (I use the word advisedly) in the hypnotic state before an audience, proceeds to suggest to the hypnotised mind all manner of absurd fancies, he may not be doing any very serious harm—though, for my own part, I should as strongly object to *my* mind being set to antics, thrown as it were into the clown groove, for however short a time But when these mesmerists go farther, as they often do, and suggest to the hypnotised mind the commission of acts which to the waking mind would be offences, the matter becomes a great deal more serious. For it has been shown that in many cases—possibly it is true in greater or less degree in all cases—the awakened mind retains something of the taint given to it while in the hypnotic condition."—*Newcastle Chronicle.*

* * *

In the cockney conundrum of one's boyhood the question was propounded, why Neptune was like an alchemist in search of the philosopher's stone? the reply being "Because he's a sea-king what'll never be found." From a recent police report it would seem that the latest appropriator of the name of the ruler of the sea has found what he was by no means seeking in the shape of a 5*l.* fine, or twenty-one days' imprisonment in default. The *soi-disant* "Neptune" in the case to which I am referring was a certain Mr. Richard Henry Penny, who cast nativities, somewhere in the purlieus of Brunswick Square, for sums varying from five shillings to "100 shillings and upwards." He does not appear to have much to thank his stars for, since they wholly failed to forewarn him that a certain Detective-Serjeant Khurt would enter "the twelfth house" (in Grenville Street) as a quasi-pryer into futurity. Perhaps no more curious illustration of the crassitude of popular ignorance could be afforded than that to be derived from the fact that this man seems to have carried on a trade in fortune-telling lucrative enough to enable him to advertise it for at least a year past.

* * *

But it seems to me that in being convicted under the Act 5 Geo. IV. c. 83, s. 4, this Grenville Street "Neptune" was a little hardly dealt with. I mean, of course, though, only relatively. Surely the law is in a defective state when it punishes a man for doing openly what the authors or editors of such trash as "Zadkiel's Almanack" do anonymously. Probably for one person who was deceived by Mr. Penny, a dozen are imposed on by publications pretending to predict future events from the aspect of the heavens; and yet the latter are sold with absolute impunity, no statute in any way touching them.

* * *

The last real astrologer is supposed to have been Morin, who quarrelled so fiercely with Gassendi when the latter abandoned astrology; and was perpetually predicting (it is needless to say quite wrongly) his opponent's death. He also fixed the date of the decease of Louis XIII., but with no better success. By-the-bye he was a fixed earth man too. But few indeed of Morin's successors have believed in their own vaticinations; in fact, if we are to stand or fall by the fundamental astrological doctrine that the whole of the events of a man's life, as well as his character, disposition, and even physique, are dependent on the aspect of the heavens at the instant of his birth, the inference is irresistible that every one born at the same time as Sir Isaac Newton must have been a consummate mathematician, of small stature, and afflicted with temporary insanity; that every man who came into the world at the same instant as Nelson must have been a born naval officer of unexampled courage and ability; and that the contemporaries in Belzoni's nativity must have all possessed the power of carrying from seven to ten men at a time with ease! The allegation has only to be stated and illustrated thus nakedly for its childish absurdity to be seen at once, and yet there are fools enough left in the world to make astrology a paying business.

* * *

Another popular superstition seems in a fair way of coming to grief. There is no vulgar error more common than that which connects the appearance of a comet with a supposed rise in terrestrial temperature; and "Comet Years" in connection with wine have become almost proverbial. The faith in this imaginary correspondence must be more robust, though, than I take it to be, if it survives the fact that no less than five comets have been visible in the sky during the present year, and that, as I write, the North Atlantic is crowded with icebergs!

THE FACE OF THE SKY FOR JULY.

By F.R.A.S.

As the period of solar activity continues, the student should daily examine the sun for the spots and faculæ which (in, however, somewhat diminished numbers) continue to appear. The night sky will be found delineated in map vii. of "The Stars in their Seasons." Up to July 21 twilight will persist from sunset to sunrise throughout the United Kingdom. Mercury is an evening star during the entire month. He may be caught with the naked eye after sunset by the keen-sighted observer, twinkling over the WNW. horizon early in July, and just to the N. of W. during the last part of the month. He attains his greatest elongation east of the sun (26°·52′) on the morning of the 19th. He will be about 3° south of Regulus ("The Seasons Pictured," plate xxiv.) on the 27th. Venus is a morning star, and may be seen in the ENE. between I and 2 A.M. She is an uninteresting telescopic object, though, now; an observation which applies, *à fortiori*, to Mars, who now appears after dusk merely as a big red star in the West. Jupiter must be looked for as soon as possible after sunset to be observed at all, as he is getting, like Mars, so rapidly towards the West. During the time that he remains visible he is travelling towards η Virginis ("The Seasons Pictured," plate xxv.). The only phenomena of his satellites certainly visible occur on July 6, when Satellite III. will leave the planet's disc at 9h. 40m. P.M.; on the 11th, when Satellite I. will exhibit the same phenomenon at 9h. 47m. P.M.; and on the 18th, when Satellite I. will enter on to the face of Jupiter at 9h. 28m. P.M. Saturn has gone for the season, as has Neptune, but Uranus

may still possibly be caught somewhat to the south of η Virginis ("The Seasons Pictured," plate xxv.). The moon is new at 10h. 6·6m. on the night of the 1st, and enters her first quarter at 1h. 18·2m. P.M. on the 8th. She is full at 3h. 8·9m. A.M. on the 16th, enters her last quarter at 7h. 21·4m. in the morning of the 24th, and will be new for the second time in July at 5h. 25·8m. A.M. on the 31st. The major part of the occultations of stars by the moon this month happen between 3 and 4 A.M., so that we do not propose to refer to them here. The only two occurring at even moderately convenient hours for the amateur are that of μ Ceti on the 24th, which will be occulted as it is rising at 11h. 32m. P.M. at the bright limb of the moon. It may be seen to reappear at the moon's dark limb afterwards, though, at 12h. 24m. at an angle of 267° from her vertex; and that of 85 Tauri on the 26th, which will be behind the moon when she rises, but, as in the previous case, may be seen to emerge from behind the dark limb of the moon 49 minutes after midnight, at a vertical angle of 224°. When these notes begin the moon is on the confines of Orion and Gemini ("The Seasons Pictured," plate xxiv.). She is travelling through Gemini until about 12h. 30m. on the night of the 2nd, when she enters Cancer. Her passage through the last-named constellation occupies her until 10h. 30m. A.M. on the 4th. At the hour just named she passes into Leo. Here she continues until 9 P.M. on the 6th, when she crosses the boundary into Virgo ("The Seasons Pictured," pl. xxv.). She is travelling through Virgo until 10 P.M. on the 9th. At that hour she enters Libra ("The Seasons Pictured," plate xxvi.), and, passing across it, arrives at 8.30 P.M. on the 11th at the boundary of the narrow northern strip of Scorpio. By 6 o'clock the next morning she has crossed this and emerged in Ophiuchus. At 3 A.M. on the 14th she passes out of Ophiuchus into Sagittarius; which at 3 P.M. on the 16th she leaves in turn for Capricornus ("The Seasons Pictured," plate xxi.). Her path across Capricornus is completed by 2 P.M. on the 17th, when she quits it for Aquarius. She is travelling through Aquarius until 9 P.M. on the 20th, and then she enters Pisces ("The Seasons Pictured," plate xxii.). At 2 A.M. on the 24th she leaves Pisces for the little corner of Cetus running between Pisces and Aries, and it occupies her until 4 o'clock in the afternoon of the same day to traverse this and pass into Aries ("The Seasons Pictured," plate xxiii.). The journey through Aries is completed by 7 P.M. on the 25th, and she then enters Taurus. In her passage through the last-named constellation she arrives, at 10 A.M. on the 28th at the boundary of the narrow northern prolongation of Orion. By 9 P.M. she has crossed this and emerged in Gemini ("The Seasons Pictured," plate xxiv.). Her path through Gemini is not completed until 11 A.M. on the 30th, at which hour she crosses into Cancer. Finally, at 8 P.M. on the 31st, she leaves Cancer for Leo, which constellation she is traversing when our notes terminate.

Our Whist Column.

By "Five of Clubs."

THE following game was played recently at Munich, I holding hand *B*. There is nothing remarkable about the play, but it illustrates well the disadvantage often arising from signalling. There can be little doubt that had not *Z*, by signalling, shown the almost hopeless position in which *A* and I stood, I should not have been driven to adopt, as the only chance of success, the apparently wild course of trumping my partner's best Diamond in order to get an extra trick by the cross-ruff. I may remark, however, that a little practice at double dummy play will convince the whist learner that devices such as these are often most useful.

THE HANDS.

B { S (*trumps*).—10, 5, 3. H.—A, K, 8, 7. D.—K, Kn. C.—10, 8, 7, 6. }

Y { S (*trumps*).—8, 7, 2. H.—6, 3, 2. D.—A, 9, 3. C.—K, Q, Kn, 9. }

B

Y Z

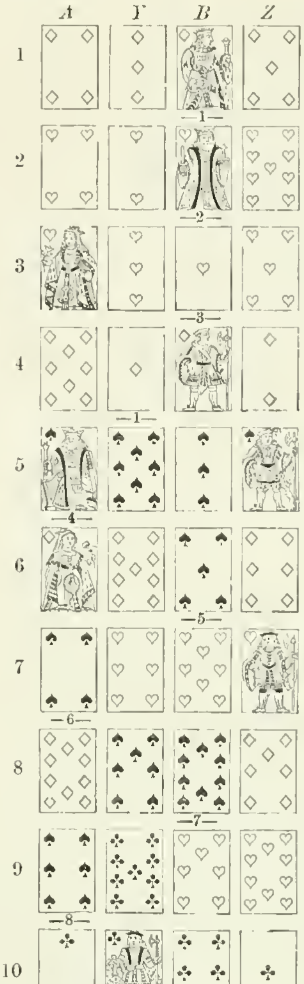
Tr. S. Q

A leads.

{ 9, Kn, Q, A.—S.(*tps*). 5, 9, 10, Kn.—H. 2, 5, 6, 7.—D. A.—C. } *Z*

A { S (*trumps*).—K, 6, 4. H.—Q, 4. D.—Q, 10, 8, 4. C.—5, 4, 3, 2. }

Score:—*A*-*B*, 3. *Y*-*Z*, 3.



NOTES.

Card underlined wins trick, card below being next lead.

1. *Z* begins a signal. Seeing that he holds the necessary two by honours in his hand he should have played a more cautious game. In any case, however, his hand was not one to signal from, despite the trump strength.

2, 3. *Z* signals in hearts. *A* has no more of the suit.

4. *B* does not force his partner, preferring to try for a cross ruff. Leading the Knave, instead of playing it to his partner's lead (after a ruff), he conceals the chance of a cross-ruff, on which he sees that the only hope of success may depend. A single ruff at this stage is likely to be of little use if *Z* has signalled with sufficient reason.

5. *Y* responds to the signal with his best trump—another unfortunate result of *Z*'s undue forwardness.

6. *B* here pursues the strategic policy initiated at trick 4. He sees that if *A*'s Queen makes, and he himself gets only one ruff, he can give *A* only one, making with that won by the Queen only three, whereas four are wanted to save the game after trick 5. Now, the chances are very small that a fourth trick can be made in Clubs or trumps, for *Z* certainly holds the Ace of trumps, and presumably all the strength in Clubs lies between *Y* and *Z*. But besides this, nothing can be lost by trumping the Diamond Queen, for not one of *B*'s small trumps can make a trick except by ruffing, and not more than two anyhow.

7, 8, 9. The cross-ruff comes off, *Y*'s unfortunate weakness in trumps not permitting him to overtrump *A*'s Spade 6.

10, 11, 12, 13. In this order the remaining tricks would doubtless have been played had the game stood otherwise than at "love all." But of course the cards were thrown up after trick 9.

Our Chess Column.

By "Mephisto."

CHESS-PLAYERS, DEAD AND LIVING.

SELF-INTEREST and every other form of egotism has been, and will always remain, the prime motor of human or animal life, in spite of anything moralists, in disregard of nature's teaching, may assert to the contrary. Thus, when a certain chess-player appeared in England, who successfully competed with the native players, he at once arrayed the self-interest of others against himself. A vague, baseless, and ungenerous kind of national egotism also came into operation against the alien. Up to the time of his arrival all work on the chess press had been considered as the hereditary property of a privileged few, who grouped them-

selves around the late Howard Staunton, jealously guarding their privileged position against the foreign intruder.

Our foreigner, although he was not an Anarchist like his countryman Most, was, nevertheless a thorough Democrat, who would acknowledge no hereditary rights of any kind, and wished to have an equal chance of competing with the favoured few for the sinecures (?) in the chess press. But, like many other Democrats, our great chess-player did not realise the fallacy of his particular belief. He failed to see that what he considered an undue privilege was only the formal recognition in that position, by consent, of those who had proved themselves the strongest and fittest, in a very long and severe contest. He forgot that when the possessors of these privileges failed to represent the implied corresponding superiority, the bastions and towers of their privileged fastness would fall, as did the walls of Jericho, but not in consequence of furious blasts from democratic trumpets, but by reason of their own weakness and decay.

Equal chance of competition, forsooth! Said the wolf to the lamb, "May the best of us win." Our chess-player soon made his influence felt in the chess press. What wonder, then, that the multitude of lambs combined against the wolf? Self-interest bade the clique of chess scribes oppose the intruding chess Hercules.

Lest some unkindly reader should accuse me of being a cynic, I hasten to say that I have a considerable amount of confidence in the generosity and benevolence of mankind; and although I must uphold my opening statement, I will gladly admit, that an appeal to, and trustful reliance in these qualities, will mostly subdue the baser instincts of human nature. Like produces like. Our foreign chess-player, unfortunately, was not nurtured in the sunshine of affection, nor did he always know contentment, though living in the land of plenty. What wonder, then, that in the struggle for supremacy, he sometimes displayed a slight acerbity, together with a too pronounced, but in his circumstances a very natural desire, to win from his opponents, and to accumulate too eagerly sundry small advantages. Needless to relate, these qualities did not appease the chess editorial lambs. On the contrary, I am grieved to say that our foreign chess-player met with but little charity.

The just tribute to his prowess as a player was often denied to him, causing an inordinate jealousy on his part to preserve his great fame. Espying this sensitiveness of the man, some of his critics deftly started a controversy calculated to wound his susceptibilities. They declared that Morphy was the greatest chess-player that ever lived—stronger than any that survived him. Our great chess-player, with a short-sightedness most curious, fell an easy prey to the enemy's tactics. He took up the challenge with avidity; thereby furnishing to everyone who chose to avail himself of the undue advantage, a ready weapon with which to inflict pain upon him. Moreover, he laid himself seriously open to the charge of egotism. He vainly believed that he would add lustre to his meritorious and great achievements as a chess-player, by belittling the play of his supposed rival.

This tactical error is all the more deplorable, because any logical person will at once admit, that there cannot be any common basis of comparison between a dead man and a living player; there could be no question of measuring strength between Morphy, then a mere youth of twenty-two, and a player of more than double that age, who had before him the example of Morphy's games, as well as the experience of a whole generation of players, to guide his play, and who, above all things, has himself enjoyed constant practice for twenty-five years. It was unfair to the dead player to maintain his play was weak, for was it not the best play of his time? It would be equally unfair to the living player to say—not without some show of reason—that if Morphy could have lived he might have eclipsed any one else. Who can tell? who has a right to base an opinion affecting any person upon a mere assumption? No, there is no common basis for such a comparison, as all the required logical conditions are wanting.

There is, however, one quality in both players, which may lead to comparisons, although in my opinion comparisons are odious. My excuse however for instituting such a comparison is, that the living player himself lately gave undue prominence to this theme. We may reasonably ask ourselves, when studying the play of both these great masters, which games inspire us with most admiration for the chess genius pure and simple, as distinguished from learned ability and strength acquired by perseverance and practice.

I will put all the enthusiasm I am capable of in my reply. Great as is the genius for the game displayed by the living player, it is surpassed in the games of Morphy, who is wrongly looked upon by his great successor as a rival in fame. Morphy was a phenomenal player, the like of whom had never been seen before. The play of the living player is well known; but by giving a few examples of Morphy's style, taken at random, the reader, by refreshing his admiration for brilliant play, will, I hope, all the more readily agree with my conclusions about chess-players, dead and living.

Position in a game between Morphy and Bird after White's seventeenth move.

MORPHY—Black.

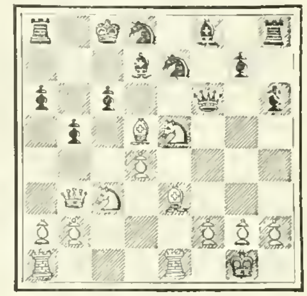
BIRD—White.

Black continued with

		R to Kt sq
17.	Castles (QR)	R × BP!
18.	B × R	Q to QR6!!
19.	P to B3	Q × RP
20.	P to Kt4	Q to R8(ch)
21.	K to B2	Q to R5(ch)
22.	K to Kt2	B × Kt P
23.	P × B	R × P (ch)
24.	Q × R	Q × Q (ch)
25.	K to B2	P to K6
26.	B × P	B to B4(ch) and wins.

Position after Black's nineteenth move in a game played between Morphy and Busserolles.

BUSSEROLLES—Black.



MORPHY—White.

White continued with

20.	Kt to K4	Q to R5
21.	P to Kt3	Q to R4
22.	Kt to Q6 (ch)	K to B2
23.	B to B3	Q to R6
24.	QR to B sq.	K × Kt
25.	B to B4	B to K3
26.	Kt to Q3 (ch)	K to Q2
27.	R × B	Kt × R
28.	B to Kt4	Resigns.

Position in a Game between Morphy and an Amateur after Black's twentieth move.

AMATEUR—Black.

MORPHY—White.

White played

21.	R to K8	Q × R
22.	Q × B!	Q to K2
23.	Q × P (ch)	Q × Q
24.	P to B6 and wins.	

Position in a game between Morphy and Delannoy.

DELANNOY—Black.

MORPHY—White.

White continued with

19.	KR to K sq	B × B
20.	R × R	K × R
21.	R to K7 (ch)	K × R
22.	Q × P (ch)	K to K sq.
23.	Q to Kt8 (ch)	K to K2
24.	B to R4 (ch)	K to Q2
25.	Q to B7.	Mate.

CONTENTS OF No. 8.

TERMS OF SUBSCRIPTION.

"KNOWLEDGE" as a Monthly Magazine cannot be registered as a Newspaper for transmission abroad. The Terms of Subscription per annum are therefore altered as follows to the Countries named:

	s.	d.
To West Indies and South America	9	0
To the East Indies, China, &c.	10	6
To South Africa	12	0
To Australia, New Zealand, &c.	14	0

To any address in the United Kingdom, the Continent, Canada, United States and Egypt, the Subscription is 7s. 6d., as heretofore.

KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART

LONDON: AUGUST 2, 1886.

THE UNKNOWABLE.

By Richard A. Proctor.

INFLUENCE OF SUN-WORSHIP ON LATER RELIGIONS.

THE phenomena of the development and of the decay of Sabaism alike bear on our interpretation not only of the past, but of the present of religion, and even on our anticipations in regard to its future.

It must have seemed clear to those who in past ages noted what the heavenly bodies seem to do and to be, that in those orbs they had recognised real powers, influencing in all-important degree the fortunes of men and nations, nay, of the whole earth. The belief and the ritual arising from this belief, the most widespread and indeed the noblest of all forms of nature-worship which civilised races have ever accepted, were the product of too many generations of thinking men, and related to too complicated a series of observed facts to be lightly thrown off even when the more observant began to perceive that the phenomena which had seemed to indicate individual power in reality are the product of continuously acting law. With the student of science in our time change of view means only the admission of previous error in regard to physical phenomena. But at the time when men first perceived that they must change their ideas in regard to the heavenly bodies, that meant for them the rejection of what had been regarded as intimately associated with the well-being of the individual man, of the race, of whole nations of races, nay, of mankind itself.

It had been held to be a solemn duty to offer daily prayers and sacrifices to the sun-god at his rising and setting, and yearly to rejoice at his new birth, at his triumphant resurrection above the equator, and at his ascension towards the fulness of his summer glory; which, as he passed thence towards the decay of his powers in autumn, rejoicing gave way to anxiety (even while the autumn fruits were gratefully collected), and anxiety to lamentation as the gloom of winter approached and deepened. In like manner the monthly movements of the moon, considered separately or connected with the varying glory of the sun, had been the occasion of observances which were directly associated with the well-being of the race. Planets and stars had taken their place in the system of observance, in various ways according to the various ideas of different nations, but with a certain resemblance between all the different cults such as might be expected from the circumstance that the objects worshipped were the same for all, and the ideas underlying the various systems of ceremonial in the main identical.

Thus can we understand, even apart from any theory of interchange of ideas between various races (though doubtless such interchange took place), how Indians, Babylonians, and Egyptians (Japhetic, Semitic, and Hammite), to say nothing of Chinese, Mexicans, and Peruvians, shared those broader religious ideas which sprang naturally from the worship of the heavenly bodies. We can see also why they had, in the main, the same notions about many matters of detail which at a first view seem merely fanciful.

Thus among all ancient races which attained any high degree of civilisation we find the idea of contest between light and darkness regarded as powers. We find light associated with good and darkness with evil. Darkness triumphs for a while over light, but light is always restored, precisely as night triumphs over day but day returns, and as the gloom of winter absorbs the glory of the sun but the sun is born again and grows again to power. The short-lasting victories achieved by night over day early lost their terrors. Men soon learned that the sun would surely return day after day to be their light and life. But it was otherwise with the mystery of the sun's annual death. Less easily interpreted, the fears it brought were less easily removed. Yet here also men learned that the victory of darkness is but temporary. The darker half of the celestial sphere imprisons the sun for a while; but though he is transpierced as he crosses the equator, yet on the third day from that on which his orb first touches the equator it has risen wholly above it.* This would be true for all parts of the earth and for all time; but many details of the sun-god's career would differ slightly, as supposed to be read in the stars, at different places and at different times. For the aspect of the zodiacal constellations, especially at rising and setting, differs with the latitude, at any given time, and the critical parts of the sun's career, his solstices and equinoxial transits, occupy different parts of the zodiac as the earth's precessional movement carries these parts backwards among the signs. The first consideration is not of any great importance, though there was a somewhat wide range of latitude among the chief civilised nations of old times; but the effects of precession affected, of course, critically the apparent significance of the sun's yearly journey. In about 2,150 years the equinoxes and solstices are carried backwards through a whole sign. Thus the vernal equinox, now in Pisces, was in Aries 2,150 years ago, in Taurus 4,300 years ago, and in Gemini 6,450 years ago. The summer solstice now in Gemini was in Cancer for 2,180 years, in Leo as long before that, and before that for 2,150 years in Virgo. When the sun is rising at the winter solstice now, or say on December 25, which in all the old systems was the date of the sun-god's annual birth, he is in the constellation Sagittarius, and the constellation Gemini is setting in the north-west; but 2,150 years ago he was in Capricornus and Cancer was setting; 4,300 years ago he was in Aquarius and the Lion was setting; while 6,450 years ago he was in Pisces, and the Virgin, with upraised arms (marked by the stars β, η, γ, δ and α), was setting in the north-western hills.

Not to dwell in detail on a number of astronomical peculiarities which would certainly influence the ideas mythically associated with a sun-god, let us consider a few of the more striking, and inquire how far they appear in the myths of India, Babylonia, Egypt, and other ancient nations which, at one stage or other of their religious development, unquestionably worshipped the heavenly bodies.

In the first place, the conception and birth of a sun-god, even if not associated with a constellation regarded as

* The sun's diameter at the spring equinox has not differed much from 32′ within the last ten thousand years (a period which would cover probably the beginnings of all known Sabaistic religions). His rate of crossing the equator is about $59\frac{1}{5}$ seconds of arc hourly, so that his disc is on the equator about $32\frac{2}{3}$ hours. If he began the crossing, for example, on Friday at noon, he would rise on Sunday, the third day, clear of the equator.

representing a virgin—as Virgo, among the nations named, assuredly did (be the explanation what it may)—would necessarily be understood to be unlike that of an ordinary being. The Supreme Being, or the Heaven Father, would be regarded as having begotten the sun-god of a virgin mother. We find this idea in all the ancient myths of the sun-god, and later it appears naturally in myths relating to divinities, or to persons of divine origin.

Osiris, of whom Murray, in his "Manual of Mythology," speaks as the Egyptian Saviour, was regarded as a virgin-born god. But he was also the father of Horus, more justly regarded as the Egyptian Saviour; and Horus was born of the virgin Isis, whose symbol (as later that of the Virgin Mary in Catholic churches) was the crescent moon.* She was, however, associated also with the Virgin of the Egyptian zodiac, and indeed in the earliest pictures of the zodiacal signs Virgo is shown as Isis. On this point the Arabian astronomer Abulmazar says, "One sees in the first Decan of the sign of the Virgin, according to the most ancient traditions of the Persians, Chaldeans, Egyptians, of Hermes and of Esculapius, a chaste, pure, immaculate virgin, of a beautiful figure and an agreeable face, having an air of modesty, holding in her hand two ears of corn, seated on a throne, nourishing and suckling a young child." Around is generally a framework of lotus-flowers. In passing it may be noted that, as Isis had brought Horus to the earth, he in return took her with him to heaven after his victory over death.

Ra, another Egyptian representative of the sun, was also a virgin-born deity. He came from the side of his mother (as we learn also happened in the case of the Buddha). Later the Egyptians came to regard their kings as of a divine nature, and attributed to them also a miraculous origin. Renouf, in his "Religion of Ancient Egypt," p. 161, says that "the Egyptians believed that their ruling sovereign was the living image and vicegerent of the sun-god (Ra). He was invested with the attributes of divinity," and Ra was regarded as his father, the mother remaining virgin.

In India many Avatars, or incarnations of Vishnu—the second person of the India *Trimurti* or Trinity—are recorded, insomuch that the Indian pundits (Moor tells us in his "Pantheon") rather despise their English rulers as being of so recent a race that they know of only one Avatar. In each case the new-born god had a virgin mother.

Crishna Jezeus was the eighth, and, according to many, the greatest of the Avatars; for while it was held that in the seven preceding incarnations a portion only of the deity was communicated, in this Vishnu himself descended in all the plenitude of the godhead. Crishna was born of Devaki, a chaste virgin. Vishnu proclaimed his intention to thus visit the earth "to relieve the oppressed world from its load," on which a chorus of angels sang aloud. In the birth-throes of this famous woman all nature shall have cause to rejoice. "Eulogised by the gods," says the Vishnu Purana, "Devaki bore in her womb the lotus-eyed deity, the saviour of the world." "The divine Vishnu himself," says the same sacred book elsewhere, "adored by Brahma and all the deities, he who is without beginning, middle, or end, being moved to relieve the earth of her load, descended into the womb of Devaki, and was born as her son; Vasu deva—that is, Crishna." Later this Purana remarks that "Crishna is the very supreme Brahma, though it is a mystery how the Supreme should assume the form of a man."

All this, however strange it may seem to us, was the natural product of a religion which originally involved the worship of the sun as the Supreme God. The ever-recurring new birth of the sun-god merged naturally into the doctrine of the incarnation, at longer intervals, of a deity of whom the sun was regarded in later times as only the symbol. A saviour, or even a teacher, who had not that sign of divine origin which the sun-god had possessed would have had small chance of being received with due veneration among races who still retained all the superstitions of sun-worshipping days.

The next among the virgin-born saviours—the ninth Avatar—among the Indians was Buddha, born of the virgin Maya (estimated date about 500 B.C., following the eighth Avatar by about 700 years). In a dream, Maya saw a white elephant, emblem of the sun, enter her right side. The dream was interpreted to signify that the child which should be born to her should be the chief of all the world, the Buddha, "able to save and deliver the world and men from the deep sea of misery and grief." This at least was the account developed in later times; doubtless there was a real Guatama whose birth was as natural as that of all other men. But when he took his place, after time enough had elapsed for the real events to be forgotten, among the deified benefactors or teachers of the past, he was held to have had that characteristic origin which the sun god of earlier ages had had, and which every deity who was to receive the veneration of the world was bound (in those times at any rate) to have. (A certain advancing keenness of ideas is shown by the circumstance that the Grand Llama, though vicegerent of God and representative of the Buddha on earth, is not at present regarded as necessarily a virgin-born being, as the Egyptians expected their king to be.)

The Siamese had a virgin-born saviour, Codom, who was placed by his mother in the folds of a lotus, and growing up became a marvel of wisdom while still a boy. The date of this divinity's miraculous birth is not recorded.

The Chinese had a number of virgin-born deities, chief among whom must be reckoned Fohi or Fuh-he, born 3468 B.C., the story of whose miraculous conception somewhat startled the Jesuit missionaries who first visited China, for they found the miracles they had trusted in as their best evidence counterbalanced by the much more ancient miracles related of Fuh-he. As with Horus, Vishnu, and the rest, the lotus appears in the Chinese story; indeed, a favourite account of Fuh-he's conception attributes it to the swallowing of the lotus coral fruit by his maiden mother—another form, no doubt, of the idea that the lotus was sacred to the sun-god.

Among the Greeks and Romans the idea of virgin-born divinities and heroes was so common that probably no new religious teaching presented to them without this accompaniment would have had any chance of acceptance. This was recognised by Justin Martyr in his famous and singularly suggestive "Apology," addressed to the Emperor Hadrian, in which he says, "We Christians, in asserting the doctrine of the Incarnation, say no more than you Pagans assert of those whom you style the sons of Jupiter;" and elsewhere he touches particularly on the case of Perseus, son of Zeus by a virgin mother, and honoured as a god at Athens. For, says Justin, "as to Jesus Christ's being born of a virgin, you have your Perseus to balance that." Of Mercury also, the son of Zeus, and a mortal mother Maia, and to whom a magnificent temple was raised at Cyllene, in Arcadia, the same Christian apologist remarked,

* Dr. Inman, in his "Pagan and Christian Symbolisms," remarks that the Virgin shown as the Queen of Heaven, nursing the infant, and associated with the "crescent moon," could not be more completely identified than she thus is with the Egyptian Isis and Horus. Higgins, in his "Anacalypsis" (vol. i. p. 304), points out that Isis was represented standing on the crescent moon with twelve stars surrounding her head. If an ancient Egyptian returning to this earth, as ancient Egyptians supposed they would, could travel through Europe his heart would be rejoiced by the sight of many thousands of pictures which he would regard as representing Isis and Horus, with their stars and moon.

"You Pagans have your Mercury, whom you worship under the title of the Word, and as a messenger from God." *

But there were many other virgin-born divinities and heroes in the Greek and Roman Pantheon. Apollo, who was unmistakably a sun-god, was the son of Zeus and a mortal mother, Latona. "At his birth there was joy," we are told, "among the immortal gods on Olympus, and the earth rejoicing laughed beneath the smile of heaven." Bacchus, another sun-god (for as there are many summers so were there many sun-gods), was of similar origin. He himself proclaims in the Bacch of Euripides, "I (am) Bacchus, son of Zeus (whom Semele, daughter of Kadmus, brought forth), having taken a mortal form instead of a god's." So with Æolus, Prometheus, and a host of others, as Justin Martyr ironically said, "a parcel of sons" were assigned by the writers most in vogue among the Greeks and Romans to Zeus or Jupiter, chief of the pagan gods.

In Mexico, Quetzalcoatl was a virgin-born god, as were Zama of Yucatan, Bochica among the Columbians, Manco Capac in Peru, and a host of others.

Passing from the conception to the birth of the ancient sun-god, we recognise other attributes which were naturally possessed by such a deity, regarded as representing the supreme God of Sabaoth or Ruler of the Heavenly Host.

(*To be continued.*)

* It is somewhat singular that such an Apology as Justin Martyr's should have been addressed to Hadrian, who had expressed a few years before his belief that the Christians are worshippers of the sun-god Serapis. "Egypt," he says in a letter to Servianus, A.D. 134, "which you commended to me, my dearest Servianus, I have found to be wholly fickle and inconstant, and continually wafted about by every breath of fame. The worshippers of Serapis (here) are called Christians, and those who are devoted to the god Serapis (I find) call themselves Bishops of Christ." It adds to the interest and oddness of this passage that it was written about four years after the probable date of the Gospel according to Mark, twenty years or so after the probable date of the Gospel according to Luke, and probably about thirty years after the time when the Gospel according to Matthew was written. (The Gospel according to John was certainly not then in existence, for Justin Martyr makes no mention of it in enforcing the very views which are supported by it alone among the Gospels: while Polycarp, A.D. 168, cites the authority of John in direct contradiction of the views expressed in the Gospel said to be "according to John," but really the most intensely anti-Johannine of all the books of the New Testament. For the fourth Gospel is in the main Pauline, and one has but to turn to the veritably Johannine Apocalypse to find how intensely anti-Pauline John was.)

ETNA'S ERUPTIONS.

THERE is a marked contrast between the circumstances of the eruptions of Etna which have taken place this year and in the summer of 1879, and those of the great eruption of 1868. For before the two last eruptions, the great South European volcanic system had shown but few signs of disturbance, and those only slight. But when in November 1868 Etna burst into eruption, the volcanic system of Southern Europe had been disturbed during thirteen months by subterranean movements. Scarcely a single portion of the wide area included under that name had been free from occasional shocks of earthquake. There had been shocks at Constantinople, at Bucharest, at Malta, and at Gibraltar. Mount Vesuvius, the most active though not in all respects the most important of the outlets by which that system finds relief, had been in a state of activity during the whole of the preceding year, and three several times in actual eruption. But it had seemed as though Vesuvius—owing perhaps to changes which had taken place in its subterranean ducts and conduits—had been unable to give complete relief to the forces then at work beneath the southern parts of Europe. Whenever Vesuvius had been quiescent for a while during 1868, earthquakes occurring at far-distant places not only showed the connection which exists between the action of Vesuvius and the condition of regions far remote from Vesuvius, but that the great Neapolitan outlet was not able to relieve as usual the remote parts of that wide volcanic region. Even in England and Ireland there were earthquakes, at times corresponding significantly with the temporary quiescence of Vesuvius. In fact, scarcely ten days had passed after the occurrence of an earthquake which alarmed the inhabitants of Western Europe, before a great eruption of Vesuvius began. A vast cone was thrown up, from which the imprisoned fires burst forth in rivers of molten lava; and round the base of this cone other smaller ones formed themselves which added their efforts to that of the central crater, and wrought more mischief than in any eruption of Vesuvius since that of 1797.

But, enormous as was the quantity of lava which those cones poured forth, it would seem that Vesuvius was still unable to give perfect relief to the imprisoned gases and fluids which had long disturbed the South of Europe. All that Vesuvius could do had been done; the smaller cones had discharged the lava which communicated directly with them, and had then sunk to rest; the great cone alone continued—but with diminished energy—to pour forth masses of burning rock and streams of liquid lava. That the imprisoned subterranean fires had not fully found relief was shown by the occurrence of an earthquake at Bucharest, late on the evening of November 27, which was only a day after the partial cessation of the eruption of Vesuvius. Probably the masses of liquid fire which had been flowing towards Vesuvius had collected beneath the whole of that wide district which underlies Etna, Stromboli, and the Neapolitan vents. Be this as it may, it is certain that but a few hours after the occurrence of the earthquake in Wallachia, Mount Etna began to show signs of activity, and by the evening of November 28, 1868, was in violent eruption.

When we consider these circumstances in connection with the recognised fact that Etna is an outlet of the same volcanic system, we can hardly be surprised that the ineffectual efforts of Vesuvius should have been followed by an eruption of the great Sicilian volcano. We can imagine that the lakes of fire which underlie the Neapolitan vent should have been inundated, so to speak, by the continual inrush of fresh matter, and that thus an overflow should have taken place into the vast caverns beneath the dome of Etna which had been partially cleared when the Sicilian mountain was in eruption in 1865. During a whole year some such process had probably been going on, until at length the forces which had been silently gathering themselves were able to overcome the resistance of the matter which stopped up the outlets of Etna, and the mountain was forced into violent and remarkably sudden action.

Unlike Vesuvius, Etna has always, within historic times, been recognised as an active volcano. Diodorus Siculus speaks of an eruption which took place before the Trojan war, and was so terrible in character as to drive away the Sicani who had peopled a neighbouring district. We learn also from Thucydides that in the sixth year of the Peloponnesian war a lava stream destroyed the suburbs of Catania. This eruption, says the historian, was the third which had taken place since the island had been colonised by the Greeks. Classical readers will scarcely need to be reminded of Pindar's graphic description of the eruption which took place fifty years before the one referred to by Thucydides. Although the poet only alludes to the mountain in passing,

he has yet succeeded in presenting with a few skilful strokes the solemn grandeur of ancient Etna, the scene of the struggles of the buried giant Typhœus. He portrays the snowy mountain as "the pillar of the heavens, the nurse of eternal snows, hiding within deep caverns the fountains of unapproachable fire: by day a column of eddying smoke, by night a bright and ruddy flame, while masses of burning rock roll ever with loud uproar into the sea."

The cone of Etna rises to more than twice the height of Mount Vesuvius. Of old, indeed, the Sicilians assigned to their mountain a height not falling very far short of that of the grandest of the Alpine mountains. But in 1815, Captain (the late Admiral) Smyth ascertained by a careful series of trigonometrical observations that the true height of the mountain is 10,874 feet. The Catanians were indignant that a young, and at that time undistinguished, Englishman should have ventured to deprive their mountain of nearly 2,000 feet of the height which had been assigned to it by their own observer Recupero, and they refused to accept the new measurement. Nine years later, however, Sir John Herschel from barometrical observations estimated the mountain's height at 10,872½ feet. The close agreement between the two results was spoken of by Herschel—Lyell tells us—as a "happy accident;" but, as Dr. Wollaston remarked, "it was one of those accidents which would not have happened to two fools."

The figure of Etna is a somewhat flattened cone, which would be very symmetrical were it not that on the eastern side it is broken by a deep valley called the Val del Bove, which runs nearly to the summit of the mountain, and descending half-way down its banks is connected with a second and narrower valley, called the Val di Colonna. The cone is divided into three regions called the desert, the woody, and the fertile regions. The first of these is a waste of lava and scoriæ, from the centre of which uprises the great cone. The woody region encircles the desert land to a width of six or seven miles. Over this region oaks, pines, and chestnut trees grow luxuriantly, while here and there are to be seen groves of cork and beech. Surrounding the woody region is a delightful and well-cultivated country lying upon the outskirts of the mountain and forming the fertile region. This part of Etna is well inhabited, and thickly covered with olives, vines, and fruit trees. One of the most singular peculiarities of the mountain is the prevalence over its flanks of a multitude of minor cones, nearly a hundred of which are to be seen in various parts of the woody and fertile regions. Of these Sir Charles Lyell remarks that, "although they appear but trifling irregularities when viewed from a distance as subordinate parts of so imposing and colossal a mountain, they would, nevertheless, be deemed hills of considerable magnitude in almost any other region."

It has been calculated that the circumference of the cone is fully eighty-seven English miles, but that the whole district over which the lava extends has nearly twice that circuit.

Of the earlier eruptions of Mount Etna we have not received very full or satisfactory records. It is related that in 1537 the principal cone, which had been 320 feet high, was swallowed up within the hollow depths of the mountain. And again in 1693, during the course of an earthquake which shook the whole of Sicily and destroyed no fewer than 60,000 persons, the mountain lost a large portion of its height, insomuch that, according to Boccone, it could not be seen from several parts of the Valdemone, whence it had before been clearly visible. Minor cones upon the flanks of the mountain were diminished in height during other outbursts in a different manner. Thus in the great eruption of 1444 Monte Peluso was reduced to two-thirds of its former height by a vast lava stream, which encircled it on every side. Yet, though another current has recently taken the same course, the height of this minor mountain is still three or four hundred feet. There is also, says Sir Charles Lyell, "a cone called Monte Nucilla, near Nicolosi, round the base of which successive currents have flowed, and showers of ashes have fallen, since the time of history, till at last, during an eruption in 1536, the surrounding plain was so raised that the top of the cone alone was left projecting above the general level."

But the first eruption of which we have complete and authentic records is the one which occurred in the year 1669. An earthquake had taken place by which Nicolosi, a town situated about twenty miles from the summit of Etna, was levelled to the ground. Near the site of the destroyed town two gulfs opened soon after, and from these gulfs such enormous quantities of sand and scoriæ were thrown out that a mountain having a double peak was formed in less than four months. But, remarkable as was the evidence thus afforded of the energy of the volcanic action which was at work beneath the flames of the mountain, a yet more striking event presently attracted the attention of the alarmed inhabitants of the neighbouring country. On a sudden, and with a crash which resounded for miles around, a fissure, *twelve miles in length*, opened along the flanks of the disturbed mountain. The fissure extended nearly to the summit of Etna. It was very deep—how deep is unknown—but only six feet in width. Along its whole length there was emitted a most vivid light. Then, after a brief interval, five similar fissures opened one after another, emitting enormous volumes of smoke, and giving vent to bellowing sounds which could be heard at a distance of more than forty miles.

At length the eruption commenced in earnest. The volume of lava which was poured forth was greater than any that has ever been known to flow from the mountain during historical times. According to the estimate of Ferrara, no less than 140 millions of cubic yards of lava were poured down the sides of the mountain. The current, after melting down the foundations of a hill called Mompiliere, overflowed no fewer than fourteen towns and villages, some of which had as many as three thousand and four thousand inhabitants. Alarmed at the progress of the sea of lava which threatened to overwhelm their city, the Catanians upreared a rampart of enormous strength and sixty feet in height. So stoutly was this bulwark established that the lava was unable to break it or to burn it down. The molten sea gradually accumulated, until at length it rose above the summit of the rampart, from which it poured in a fiery cascade, and destroyed the nearer part of the city. "The wall was not thrown down, however," says Sir Charles Lyell, "but was discovered long afterwards by excavations made in the rock by the Prince of Biscari, so that the traveller may now see the solid lava curling over the top of the rampart as if still in the very act of falling. The current had performed a course of fifteen miles before it entered the sea, where it was still 600 yards broad and 40 feet deep. It covered some territories in the environs of Catania, which had never before been visited by the lavas of Etna. While moving on, its surface was in general a mass of solid rock, and its mode of advancing, as is usual with lava streams, was by the occasional fissuring of the solid walls. A gentleman of Catania, named Pappalardo, desiring to secure the city from the approach of the threatening torrent, went out with a party of fifty men whom he had dressed in skins to protect them from the heat, and armed with iron crows and hooks. They broke open one of the solid walls which flanked the current near Belpasso, and immediately forth issued a rivulet of melted matter which took the direction of Paterno; but the inhabitants of that town, being alarmed

for their safety, took up arms and put a stop to further operations."

In the eruption of 1755 a singular circumstance occurred. From the Val del Bove, usually dry and arid, there flowed a tremendous volume of water forming a stream two miles broad, and in some places 34 feet deep. It flowed in the first part of its course at the rate of two miles in three minutes. It is said to have been salt, and many supposed it had been in some way drawn from the sea, since its volume exceeded that of all the snow on the mountain. It has, however, since been found that vast reservoirs of snow and ice are accumulated in different parts of the mountain beneath the lava. The snow was melted by the heat of the rising lava, and was made salt by vaporous exhalations.

Of the singular solidity of the walls of an advancing lava stream, Recupero has related a remarkable instance. During the eruption of 1766, he and his guide had ascended one of those minor cones which lie, as we have said, on the flanks of the mountain, and from the summit of this hill they watched with feelings of awe the slow advance of a fiery river two miles and a half in breadth. Suddenly they saw a fissure opening in the solid walls which encircled the front of the current of lava; and then from out this fissure two streams of lava leaped forth and ran rapidly towards the hill on which the observers were standing. They had just time to make their escape, when, turning round, they saw the hill surrounded by the burning lava. Fifteen minutes later the foundations of the hill had been melted down, and the whole mass floated away upon the lava, with which it presently became completely incorporated.

It would be a mistake, however, to suppose that such an occurrence as the one we have just related is often observed. On the contrary, it seems that when burning lava comes into contact with rocky matter, the latter is usually very little affected. It is only when fresh portions of incandescent lava are successively brought into contact with fusible rocks that these can be completely melted. Sir Charles Lyell quotes a remarkable story in illustration of the small effects which are produced by lava when there is not a continual supply of fresh material in an incandescent state. "On the site of Mompiliere, one of the towns overflowed in the great eruption of 1669, an excavation was made in 1704: and by immense labour the workmen reached, at the depth of 35 feet, the gate of the principal church, where there were three statues held in high veneration. One of these, together with a bell, some money, and other articles, was extracted in a good state of preservation from beneath a great arch formed by the lava." This will seem the more extraordinary when it is remembered that eight years after the eruption the lava was still so hot at Catania, that it was impossible to hold the hand in some of the fissures.

Among the most remarkable of the eruptions of Etna which have taken place in recent times are those of 1811 and 1819.

In 1811, according to Gemmelaro, the great crater gave vent, at first, to a series of tremendous detonations, from which it was judged that the dome of the mountain had become completely filled with molten lava, which was seeking to escape. At length a violent shock was experienced, and from what followed it would seem that by this shock the whole internal framework of the mountain had been rent open. For, first, a stream of lava began to pour out from a gap in the cone not far from the summit. Then another stream burst out at an opening directly under the first, and at some distance from it. Then a third opening appeared, still lower down; then a fourth, and so on, until no less than seven openings had been formed in succession, all lying in the same vertical plane. From the way in which these openings appeared, and the peculiarity that each stream of lava had ceased to flow before the next lower one burst forth, it is supposed that the internal framework of the mountain had been rent open gradually, from the summit downwards, so as to suffer the internal column of lava to subside to a lower and lower level, by escaping through the successive vents. This, at least, is the opinion which Scrope has expressed on the subject in his treatise on "Volcanoes."

(*To be continued.*)

SEA SERPENTS AND DRAGONS.*

It would be difficult to say which of the two great classes of the unthinking do most mischief—those who believe everything, or those who believe nothing. Unfortunately both classes are very numerous, and far outnumber those who believe only what they have reasoned about, and have either learned themselves or received after due consideration from those whom they recognise as competent to express an opinion.

To the foolish who believe everything we owe the wide prevalence of superstitions, from those of the most childish nature, to those which seem to have an air of respectability but in reality are only very ancient mistakes. To the foolish who believe nothing we owe in like degree the prevalence of superstitions, many of them very stupid. If one set oppose all discovery, all results of original thought, because inconsistent with their beloved superstitions, the other equally oppose all new truths because inconsistent with their narrow range of ideas. And although one might imagine the opinion of neither set to be of any importance, unfortunately men are apt in such matters to count heads rather than to weigh brains; and it is certain that the number of those whose opinion has been of no weight has enormously exceeded in all ages that of those who can render a reason and are therefore worth listening to.

This might matter little if only matters of scientific interest were in question, but matters of political and religious importance are dealt with in the same foolish way. The many who believe every absurd superstition, and the many who believe nothing—the fatuously credulous and the rampantly infidel—have done equal mischief to the cause of true religion; and the name of either class is legion, as revivals and religious disputes alike testify. The many who retain all the mistakes of past ages in matters political, and the many who have no faith in any form of government—the imbecile "subject" and the foolish anarchist—have done equal mischief to the cause of true political progress, and of these also the name is unfortunately "legion," as the last general election (wherever and whenever it took place) abundantly shows.

We may fairly take the conduct of men in some matter of scientific inquiry as typical of their conduct in those more important matters—politics and religion. The book before us presents an interesting set of specimens, (1) of readiness to believe *everything* about floods, dragons, sea-serpents, unicorns, and so forth, and (2) of the equally stupid incredulity which has caused as many foolish persons of another class to raise loud hee-haws when anything has been described which was a little outside the familiar, and to believe in *nothing* new to them.

Mr. Gould's introduction presents admirably the general argument in regard to credulity and incredulity. He perhaps dwells a little too much on the tendency to ignorant

* "Mythical Monsters." By Arthur Gould. London: W. H. Allen & Co.

incredulity, for ignorant credulity deserves quite as much to be censured. But then it must be admitted that, whereas ignorant credulity has already been widely and deeply censured, ignorant incredulity has hitherto in great degree (certainly in undue degree) escaped. Still, throughout the book before us the want of balance can be noticed. It even affects Mr. Gould's own judgment, insomuch that he greatly impairs the weight of the general evidence he brings to bear on each class of wonders he deals with, by accepting almost unquestioningly a quantity of evidence as to detail which is, to say the least, open to grave suspicion.

A very interesting section of the introductory matter is that relating to cuttlefish—which our author very properly takes as an example of a creature which has at last been shown to be, and to do, what the foolishly incredulous had laughed at as out of all reason. The accompanying picture from Mr. Gould's book presents a view painted early in the present century by the celebrated Japanese artist, Hokusai, of a fisherman attacked by a monstrous cuttlefish, even as the hero of "Les Travailleurs de la Mer" was attacked,—only the fisherman seems to be able to oppose no effective resistance. The late Frank Buckland gives an interesting account of a Japanese carving in ivory, said to be one hundred and fifty years old, representing a similar event.

FIG. 1.—FISHERMAN ATTACKED BY OCTOPUS.

It shows "a lady in a quasi-leaning attitude; and at first sight it is difficult to conceive what she is doing, but after a while the details come out magnificently. The unfortunate lady has been seized by an octopus while bathing, for the lady wears a bathing-dress. One extended arm of the octopus is in the act of coiling round the lady's neck, and she is endeavouring to pull it off with her right hand; another arm of the monster is entwined round the left wrist, while the hand is fiercely tearing at the mouth of the brute. The other arms of the octopus are twined round, grasping the lady's body and waist—in fact, her position reminds one very much of Laocoon in the celebrated statue of the snakes seizing him and his two sons. The sucking discs of the octopus are carved exactly as they are in nature, and the colour of the body of the monster, together with the formidable aspect of the eyes, are wonderfully represented. The face of this Japanese lady is most admirably done; it expresses the utmost terror and alarm, and possibly may be a portrait."

The cuttlefish is an excellent example of the slow progress of discovery when obstructed by incredulity of the crassly stupid sort. Because ignorant newspaper writers loaded with abuse every fresh piece of evidence showing the enormous size these creatures attain, and that some could destroy an animal much larger and stronger than man, those who had such evidence preferred not to give it. Only the lucky accident that one or two large cuttlefish were fortunately stranded where there happened to be an intelligent observer or two, while two very large cuttlefish were killed, caused the stories which had been so often and so persistently ridiculed to be recognised as simply accounts of facts. The giraffe, the hippopotamus, the gorilla, and a number of other animals whose existence had been unsuspected or forgotten, gave similar exercise to the cachinnatory powers of the scribblers who represent the foolishly incredulous.

The evidence deduced by Mr. Gould from the extinction of species associated with the evidence based on the continued existence of species—the catfish, for example, still found in the Missouri is a survival of the Silurian era—deserves to be most carefully studied. The recognition of the antiquity of man is also most important in this connection, showing that though, if man had lasted but a few thousand years, we could hardly understand myths of such creatures as the great saurians and bats of long past ages, such memories become very easily intelligible when we find that man has existed many tens of thousands—perhaps many hundreds of thousands—of years upon the earth.

With Mr. Gould's discussion of deluge myths we are not satisfied. It appears to us that all the circumstances in which such myths agree and those in which they disagree are alike explained by a much simpler theory. All races who built large structures, or excavated the earth to any considerable depth, must have recognised the signs of the past presence of the ocean where, in their own time, there was dry land. The Assyrians and Babylonians, the Egyptians, the Persians, and the Indians—all the civilised races of antiquity had eyes to see, and minds wherewith to consider, the evidence which geologists have found convincing in regard to the interchange of land and water. On the sandy plains around the pyramids are found the remains of a tertiary ocean, sea-shells as perfect as those which are rolled upon the shores of our existing seas. In the excavations made by the Assyrians and Babylonians similar evidence came to light. The Indians, Persians, Chinese, Mexicans,—all such nations had evidence of the kind. How could they fail to infer that the seas had once stood where they saw the remains of creatures which only exist in the sea? And uniting this evidence with that derived from partial floods, such as occur in nearly all countries, or in Egypt with the study of the varying overflow of the Nile, what opinion could they form but that, in some remote past age, there had been a great flood destroying all their country? In them that idea would be the idea of a universal flood,

destroying all life, except either such life as might be saved in ships, or such life as might by a miracle be restored to the earth after the waters of the flood had passed away. The story of the Flood, in one or other of the forms combined—oddly enough—in Hebrew records (borrowed, beyond a doubt, from both Egypt and Babylonia), is so far from being a surprising matter, that, considering the multitudinous evidence of the past presence of the seas over regions now high above the sea level, it might fairly have been anticipated that some such story would start into existence in every community which passed beyond the savage state. Even some contrivance for boxing the animals in a sufficiently large vessel would seem absolutely necessary to those who saw that waters had once stood even above mountain heights. For, in the first place, they had no means of knowing how changes of level had brought this about without destroying all forms of animal life; while, in the second place, they knew not what an immense number of forms of life from the various classes of elephants, rhinoceroses, hippotamuses, giraffes, &c., down to creatures too minute to have been noticed by them, must have been boxed within that unsavoury compass if their idea had been sound.

But the chief interest of Mr. Gould's book undoubtedly resides in his discussion of the curious evidence relating to dragons and sea-serpents.

As to dragons, it appears to us that the only reason there ever has been for doubting the existence of large winged creatures, or dragons, in former ages, such as now unquestionably no longer exist, is that based on the supposition that all animals made in the beginning, some six thousand years ago, exist at present. This supposition, absurd as it seems now, was once nearly universal. And it was natural enough. How could men attain to the knowledge that there had been life on the earth, in the sea, and in the air millions of years ago, until a long and careful study of the evidence had forced the truth upon them? Viewing matters as all men did in the Middle Ages, and as most men (despite our boasted progress) view matters still, the belief in dragons could only arise as a superstition after the creatures themselves, whatever they may have been, had disappeared. By special creative act a monstrous dragon might be made, and set in some gloomy cave within a forest, as a punishment for the misdeeds of men, or perhaps of their inability to believe in the right sort of deity. The idea that one dragon necessarily implied the existence of hundreds and the past existence of hundreds of thousands, would have seemed absurd to men who could believe in whole nations of men as sprung from single pairs, like Abraham and Sarah, Lot, Esau, Ishmael, and their respective spouses.

But to us who not only believe but *know* that life has existed on the earth, in the sea, and in the air during many millions of years, it is much more difficult to reject the old stories of dragons than to accept them. Of course there were exaggerations, as there have been in the case of the elephant, the giraffe, the crocodile, the boa constrictor, the condor, and so forth. But the general truth of dragon stories, rejected only because of an ingrained belief in erroneous ideas as to the origin of life on the earth, must now be admitted as at least more probable by far than the theory that such narratives are wholly false.

Moreover, we find ancient Egyptian, Indian, Greek, and Roman stories about winged serpents destructive to life, supported by Hebrew narratives. The Jews seem to have encountered on their way from Egypt the destructive serpents which are described in many ancient writings as coming out of Arabia. And the fiery serpents of Numbers are probably the same as the creatures referred to by Isaiah as fiery flying serpents. Josephus, indeed, probably describing the same event which in Numbers assumes a miraculous, and therefore necessarily untrue, aspect, distinctly describes the serpents which troubled the Jews as flying ones. "When the ground was difficult to be passed over," he says, "because of the multitude of serpents (which it produces in vast numbers . . . . and such as are worse than others in power and mischief, and an unusual fierceness of sight [aspect], some of which ascend out of the ground unseen, and also fly in the air, and so come upon men at unawares, and do them a mischief), Moses invented a wonderful stratagem to preserve the army safe and without hurt; for he made baskets like unto arks of sedge, and filled them with ibes, and carried them along with them, which animal is the greatest enemy to serpents imaginable, for

Fig. 2.—Sea-serpent seen by Hans (afterwards Bishop) Egede in 1734 off the South Coast of Greenland.

they (the serpents) fly from them when they come near them," &c. &c.

Comparing Japanese and Chinese pictures of dragons, singular though some of them are, with such pictures as fig. 1, where we see a most carefully drawn octopus (a creature which, if it were not known, would be rejected by all the foolish as impossible), we see that in all probability creatures akin at any rate to the Chinese and Japanese dragons, if not actually identical with them, must have existed in past ages.

As to the sea-serpent, it is, of course, only the very foolish, as the penny-a-liners of some of the daily papers, who now scout the idea that the accounts of strange sea-monsters, serpentine at any rate in aspect, have been truthful. Such persons, imagining the world to be full of folk like themselves, ever ready to invent all sorts of lying narratives, raise shouts of idiotic laughter at the stories of such monsters related by seamen and voyagers of good repute for sense and veracity. It may, indeed, be truly said that we owe to such stupid persons even the lying stories which have unquestionably been told about sea-serpents. For so soon as the idea has once been thrown out by the silly that silly untruths have been told about

Olaus Magnus describes two kinds of sea-serpent. But he wrote from the accounts of others, as did Aldrovandus and Arndt Bernsen. Hans (afterwards Bishop) Egede, on the contrary, figures and describes a sea-monster which showed itself on his passage (as a missionary) to Greenland. "On July 6, 1734," he says, "when off the south coast of Greenland, a sea-monster appeared to us (fig. 2) whose head when raised was on a level with our main top. Its snout was long and sharp, and it blew water almost like a whale; it had large brown paws; its body was covered with scales; its skin was rough and uneven; in other respects it was as a serpent, and when it dived its tail, which was raised in the air, appeared to be a whole ship's length from its body." The drawing (fig. 2) appears to have been made by another missionary, Mr. Bing, who stated that the creature's eyes seemed red and like burning fire.

Laurance de Ferry, captain in the Norwegian navy, actually wounded one of the Norwegian serpents, and two of his men testified on oath to the truth of his account. Bishop Gunner describes a race of sea-serpents found in the sea of Finmark. Captain (afterwards Sir Arthur) de Capell Brooke collected accounts of a sea-serpent seen several times from July 1849 till the warm weather was

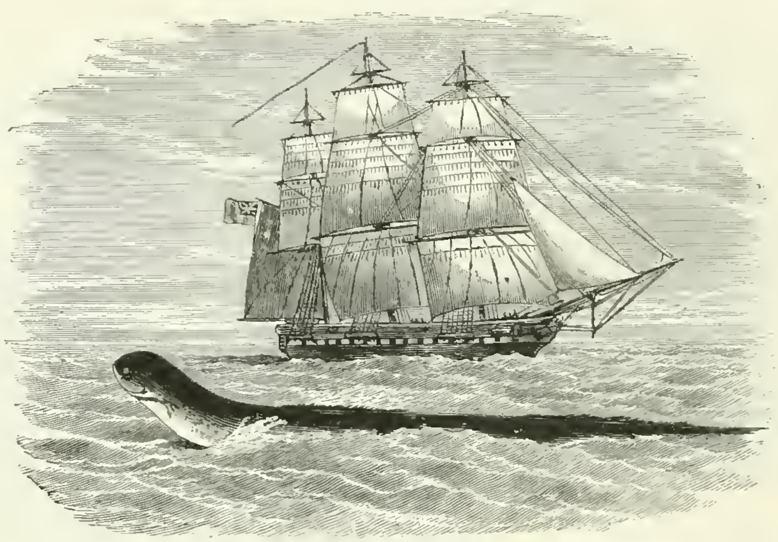


Fig. 3.—Sea-serpent seen by the Officers and Crew of the Government Frigate (or, in the vulgar, Her Majesty's Ship) "Dædalus" in 1848.

sea-serpents, their kindred, the tellers of silly falsehoods, are sure to be tempted to supply really false stories of sea-serpents, were it for no other purpose than to prove that such falsehoods may be told.

Although some of the stories told by Pontoppidan, the Bishop of Bergen, may have been exaggerated, there is no sufficient reason to reject the general evidence supplied to him by Northern traders in regard to the existence of strange sea-monsters. His "Natural History of Norway" was published in 1755—not in the third or fourth century as many seem to imagine, who discredit all his accounts as the product of credulous ages like those which accepted the stories handed down to us by the early Fathers. He tells us he had the evidence of creditable and experienced fishermen and sailors in Norway, of which there are hundreds who can testify that they have annually seen "sea-serpents. The North traders, he adds, who came to Bergen every year with merchandise thought it a very strange question when they were seriously asked whether there were any such creatures—as ridiculous, in fact, as if the question had been put to them whether there be such fish as eel or conger."

over. These are given in full in Mr. Gould's book. A similar animal was seen in 1822, in 1845, and 1848. The Rev. Alf. C. Smith, writing in 1850, summarises thus the result of his investigations: "I cannot withhold my belief in the existence of some huge inhabitant of those Northern seas, when, to my mind, the fact of his existence has been clearly proved by numerous eye-witnesses, many of whom were too intelligent to be deceived, and too honest to be doubted."

We may mention next a sea-serpent seen and described by Mr. MacLean, parish minister of Eigg, in 1809; another seen and described by the Rev. John McRae, of Glenelg, and the Rev. David Twopeny, vicar of Stockbury, Kent; and another seen in 1882 by Mr. Barfoot, J.P., of Leicester, Mr. Marlow, solicitor, of Manchester, Mrs. Marlow, and several others, near the Little Orme's Head.

In American waters the sea-serpent has been seen several times on the coast of Maine—possibly the same creature—during the thirty years preceding 1809. Eleven depositions were taken, the witnesses being persons of unquestioned veracity. In 1819 a similar animal was seen off Nahant. In 1847 five officers of the garrison at Halifax, when on a

fishing excursion, saw a sea-serpent—by which name, here and elsewhere in this article, we mean to imply only a creature corresponding, so far as appearances went, with the animal which has been so called.

The sea-serpent seen by the captain and officers of the Government ship *Dædalus* is shown in fig. 3. There is an account of this creature in one of the volumes of the Knowledge Library Series, either "Rough Ways made Smooth," or "Pleasant Ways in Science," we forget which.* Numbers of other cases in which strange sea-monsters were seen are described in full in Mr. Gould's most interesting volume. It contains nearly a hundred curious illustrations, besides the three which Messrs. W. H. Allen & Co. have been good enough to lend us for this article.

The chapters on the Unicorn and the Phœnix will be found well worth reading.

SOME PUZZLES.

During a recent transatlantic voyage, a section of the passengers agreeably passed a portion of the time by proposing puzzles of various sorts, and endeavouring to solve puzzles set by others. Doubtless many of the puzzles thus set were old enough; yet if they were new to those who tried them they gave not less pleasure though they might be ancient to the puzzle-solving world. Many a half-hour which might otherwise have been dreary enough was pleasantly employed in trying to turn each set of letters, ASONUIS, NEW DOOR, and HOATS into one word; the field of three squares, formed by cutting out a quarter from a large square, was divided into four equal and similar divisions, in the manner familiar to most of us, after considerable mental exercise, by those unfamiliar with the problem; and many arithmetical and geometrical puzzles of greater or less interest and difficulty were set and discussed.

It occurred to the writer of these lines that in such exercises we have in reality as useful a mental discipline as our universities in their wisdom give for the training and testing of men who are to be our lawyers, our doctors, and above all our divines. In verse making, Latin or Greek, for example, we have verbal puzzledom. In problems about triangles, squares, circles, and so forth, we have geometrical puzzledom. In algebra, the differential calculus, and the calculus of variations, we have arithmetical puzzledom. It is all, no doubt, highly beneficial. It at least serves to pass away the *ennui* of three or four years in college. And though perhaps future ages and races hereafter to inherit the earth may somewhat wonder at the system—*as applied* in testing men's fitness for religious, legislative, political, philosophical, and scientific careers—they will have to admit, I suppose, that it had its pleasing aspect.

Further, it appears to us that the study of such puzzles as are set merely for amusement may be made useful in the way of instruction. For instance, when the familiar puzzle is set which relates to the farmer, ignorant of numbers, who left 17 horses to his three sons (or, equally well it may be, an Arab sheik who left 17 camels), half to the eldest, a third to the second, and a ninth to the youngest, the solution sets the inquirer, who also may have been somewhat ignorant of numbers, to the discussion of fractions in a practical way, and may throw more light on this useful department of arithmetic than much study of arithmetical rules from books.

Then a puzzle of this sort lends itself to consideration in the way of extension or amendment. For instance, suppose the same problem set about 35 camels, with the additional requirement that the cadi (whatever a cadi may be) who settles the dispute shall not only satisfy the three sons but take one animal for himself—the sons being as ignorant of numbers as their papa—then we have an amusing as well as an instructive problem. The solution might run somewhat as follows:—

The cadi being appealed to, said, after the manner of cadis, "Because I cannot carry out your father's wishes without making you a present of a camel, I will generously bestow upon you my favourite camel Fatima; let her be added to your father's bequest." Then, standing at the door of the stable, he said to the eldest son, "How many of these 36 camels do you claim as your half?" And the eldest son answered, "I claim 18, thanks to your generosity, oh cadi, in adding Fatima to my father's camels." "Let 18 camels be forthwith given to this youth," said the cadi to his servants; and 18 camels were accordingly led forth and taken away by the intelligent young man. "And you, oh promising second son of an arithmetical father," gravely remarked the generous cadi, "how many do you claim as your third?" And the lad safely replied, "I claim 12." Twelve camels, therefore, were led forth; and the second son departed rejoicing, for that he had received more than his father had bequeathed unto him. "And now, oh my son," said the cadi, standing with his servants around the front door of the stable, "how many camels do you count as your share—one-ninth part—of your father's bequest?" "Nay, oh my lord," replied the boy, scratching his head after the manner of a puzzled Giaour, "I cannot tell how many camels the ninth part of 35 may be; but now that your resplendent generosity has added the beauteous Fatima to the number, making it 36, I find that the ninth part thereof amounts, according to the infidel Cocker, to four: and I beg that I may take away so many." Then the cadi replied, with a beaming smile, "Oh boy, thou hast counted aright; nine times four are assuredly thirty-six. Take, then, thy four camels, according to thy father's bequest." And the boy departed rejoicing, with his four camels, which the cadi's servants led forth from the front door of the stable. Howbeit, when the lad had departed from before the front door, the cadi's servants led forth two camels from the door at the back. And when the three sons met soon after, they found that, strange to say, the much-admired Fatima, which the cadi had generously bestowed upon the family, had not fallen to the lot, either of the eldest, of the second, or of him that was youngest of birth. "Doubtless," said they, "El Shaitan has transformed it into a camel of less noble aspect."

A favourite puzzle, always sure to find some to whom it presents the charms of novelty and difficulty, is the fine old 64-65 fraud, which was probably invented by some commercial traveller from the far East—a bagman of Bagdad so to speak. We suppose all the readers of Knowledge know this old puzzle. A square, ABCD, fig. 1, like a chess-board, is divided by the lines BE, EF, and GH, into four parts, and a coin, say a sovereign, is put, or supposed to be put, on each square. Then the pieces are arranged as shown in fig. 2, and it is found that the 64 sovereigns will not cover the squares now formed, of which there are 65.

The explanation of the apparent mystery is simple enough.

* We may add here that Capt. McQuhae invited all who had seen the creature, and had any skill in drawing, to depict it to the best of their recollection. They did this without having any chance of comparing their drawings together; and the pictures, when finished, were collected and placed under seal. I have this on the authority of a commander in the Government navy, who informed me also that British officers laugh at Prof. Owen's fond conceit that the sudden alarm caused the officers and crew of a frigate to mistake a rather large sea-elephant for a sea-serpent.

Yet in any large gathering of persons variously trained mentally, one or two will nearly always be found who are quite unable to interpret the puzzle, and who appear to regard the extra square in the long rectangle as the work of the enemy of mankind. Probably some of those taken in by the Bagdad bagman attributed their loss to Ahriman in veritable earnest.

But simple as this puzzle is, it is very seldom set as it should be; insomuch that as usually set a keen eye will readily detect the imperfect nature of some of the squares. Of course we cannot get all the squares right by any construction, but we can double the chance of deceiving the eye by planning the trick properly. Instead of drawing a square as in fig. 1 and dividing as there shown, as is usually

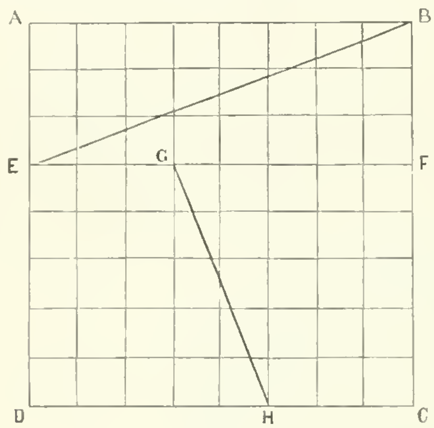


Fig. 1.

done, it is better to proceed as follows:—Draw a rectangle as in fig. 2, and then pencil lightly a straight line from B to *b*; it will be found that this pencilled line passes above *e* and below E (the nearest corners of small squares) cutting *fa* and AF in *h* and *g* respectively. Draw then a straight line from B to a point midway between *h* and E and to a point midway between E and *g*; draw also from *b* a straight line to these same points, and make cuts along these four lines. You thus remove a long parallelogram having B *b* as its longest diagonal. This, however, is only half the long parallelogram really wanting when the pieces of fig. 1 are put into the form of a rectangle having sides with five and thirteen divisions. Thus, when you complete the division by cutting along *ea* and AE, the discrepancy

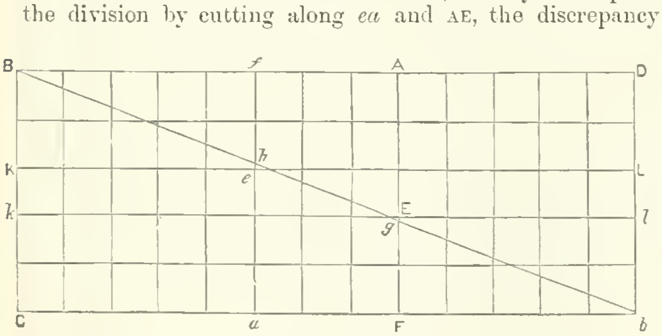


Fig. 2.

which really exists between fig. 1 and fig. 2 is equally distributed between the two arrangements, instead of all falling on one (the arrangement of fig. 2) as usual.

Of course, if the division has to be made in public, one cannot apply this method. But it is far better to have the pieces neatly cut beforehand, as the effect of the puzzle is much enhanced by having the squares all neatly drawn. By the way, the chance of deceiving even the keenest eye may be yet further increased by very slightly curving the lines *fa* KL, so as to bring their point of intersection somewhat nearer than *e* to *b*, and the like with the lines AF and KL.

Three puzzles interested us as leading to further analogies. Oddly enough, they seemed related severally, as the student may find on examining them, to the three conic sections—the ellipse, parabola, and hyperbola. We give them for solution and examination in the next number of Knowledge, noting that we cannot find space for the names of those among our readers who may solve them, so that it would be wasting postage to send solutions.

1. A farmer has 19 trees, which he wishes to arrange in 9 rows, 5 in each. How should he plant them?

2. A man has a piece of oilcloth 4 yards long by 3 feet broad, and he wishes to divide this into two portions which shall fit a hall 3 yards long by 4 feet broad; how shall he cut his oilcloth?

3. A man marks 6 straight lines on a field in such a way as to enclose 10 spaces. How does he manage this?

MIND ACTING ON BODY.

By Richard A. Proctor.

CASES, such as have been hitherto described, throw far less light on the powers which the mind possesses over the body than those in which actual organic change results from the mental act, continued long enough. The following case, in which blindness (of one eye) was certainly not dependent on defective nerve-force, is in this sense particularly interesting. Mrs. S. had had severe rheumatic fever in 1839, during the course of which the left eye was affected, in such sort that both its internal and its external structure suffered injury. In 1842, when Mrs. S. first consulted Mr. Braid, this eye was free from pain, but was useless. More than half the cornea was covered by an opaque film, any object placed opposite the outer or left half of the eye (the temporal half, doctors prefer to call it) being seen through a dense haze; and the objects placed towards the opposite side were seen very imperfectly, owing to the injury which the choroid and retina had sustained in the points on which the images of such objects were reflected. The opacity was not only an obstacle to distinct vision, but was also a source of annoyance from its disfigurement, being obvious even at a considerable distance. "Mrs. S. was a relation," Dr. Todd mentions, "of Mr. Braid, and was in his house three months before he operated upon her, during which time no change took place. Violent pain in the arm and shoulder induced her to submit to the hypnotic treatment, which proved successful; but what was more surprising, and quite unlooked for by Mr. Braid, her *sight* was so much improved that she was able to see everything in the room, and to name different flowers, and distinguish their colours, whilst the right eye was shut, which she had not been able to do for more than three and a half years previously. The operation was continued daily, and in a very short time *the cornea became so transparent that it required close inspection to observe any remains of opacity*. After the first operation there was considerable smarting in the eye, which continued all night, and in a less degree after future operations, which no doubt" (be it remembered, it is not Mr. Braid, but Dr. Todd, who expresses this opinion) "roused the absorbents, and effected the removal of the opacity. Stimulating the optic nerve to greater activity, however, must have been the chief cause of the very rapid improvement which enabled her to see objects after the second operation. Mr. Braid adds to the

foregoing, that objects were seen from the temporal side of the eye much more distinctly than from the nasal side, owing to the irreparable damage the retina and choroid had sustained."

Instances of the cure of deafness must in the great majority of cases be ascribed to the increase in the flow of nervous force along the aural nerves, and, therefore, are not quite so surprising as the case just cited and others of a like nature. Still, some of them have been very remarkable. Take, for instance, Mr. Braid's account of the cure of Nodan, a deaf mute, aged twenty-four, who, according to the opinion of Mr. Vaughan, head master of the Deaf and Dumb Institute where Nodan was a pupil, had never had the power of hearing, properly so called. "After the first operation," says Mr. Braid, "(inducing hypnotism, then extending the limbs and fanning the ears), I satisfied myself he had no sense of hearing; but after the second, which I carried still further, he could hear, and was so annoyed by the noise of the carts and carriages when going home that he could not be induced to call on me again for some time. He has been operated on only a few times, and has been so much improved, that although he lives in a back street he can now hear a band of music coming along the front street, and will go out to meet it. I lately tested him, and found he could hear in his room on the second floor a gentle knock on the bottom stair. His improvement, therefore, has been decided and permanent, and is entirely attributable to hypnotism, as no other means were adopted in his case." In other words, the cure was entirely attributable to that special form of mental activity which is excited, or, at any rate, becomes available, in the case of hypnotised patients.

We have seen how, through the influence of the mind upon the body, the blind have been made to see, the deaf to hear; we may next consider cases in which the lame have been made to walk—nay, even to dance—by no other influence. Among the experiments by which it was shown that wooden tractors are as effective, *if only they are properly painted*, as iron ones, Dr. Alderson mentions the following:—"Robert Wood, aged sixty-seven, on June 4 was operated upon with wooden tractors for a rheumatic affection of the hip, which he had had for eight months. During the application of the tractors, which was continued for about seven minutes, no effects were produced, except a profuse perspiration and a general tremor. On ceasing the application of the tractors, to his inexpressible joy and our satisfaction, the good effects of our labour were now produced and acknowledged; for he voluntarily assured me that he could walk with perfect ease, that he had the entire motion of the joint, and that he was free from pain—to use his own words: 'As to the pain I have now, I do not care if I have it all my life; that will matter nothing. You may take your medicines—I'll have no more of them!' And, prior to his leaving the infirmary, he remarked how very warm those parts were where the tractors had been applied; and then walked from the infirmary to his own house, assuring his companion that he could very well walk to Beverley." In another case no tractors were used, or any other mysterious form of apparatus employed to excite attention. The attraction used was not magnetic or electrical, but an attraction of a very different kind, not as yet considered among medical remedies—except, by the way, in one case which occurs to me at the moment, and will be found fully recorded, prescription and all, in the pages of "Hard Cash," though the remedy is there prescribed to cure an ailment for which it seems in some degree more appropriate. A young lady of sixteen (we are describing a real case, not the case of Julia Dodd) had for many months been suffering from an inversion of the left foot, which was twisted at right angles with the other, and was treated by orthopædic surgeons with an elaborate apparatus of splints. Neither they nor Mr. Skey (though he recognised the nature of the affection) succeeded in curing it. Psychical agents, however, effected a cure in a few minutes. She willed to use her foot like other people, and she did. "She accompanied her family to a ball," says Mr. Skey, in the *Medical Times and Gazette* for October 13, 1866; "her foot, as she entered the ballroom, being not yet restored to its normal position. She was invited to dance, and, under this novel excitement, she stood up, and, to the astonishment of her family, she danced the whole evening, having almost suddenly recovered the healthy muscular action of the limb. She came to me two days afterwards. She walked perfectly well into my room, and paced the room backwards and forwards with great delight. The actions of the limb were thoroughly restored, and all trace of the previous malady had disappeared."

After reading such accounts as these, accounts given by sober-minded medical men, who would naturally be inclined rather to limit unduly than unduly to exaggerate the power which the mind of the patient may possess over the diseased body, it becomes easy to explain the accounts of seemingly miraculous cures which are published from time to time in various religious (and also in some scarcely religious) journals. Amongst such cases may be cited as particularly credible, when once the influence of the imagination is recognised, the so-called miracles performed by Prince Hohenlohe, for he combined with the princely title,* and the imagined efficacy of royal blood, the attributes of the priest, and personal qualities admirably suited to influence the minds of the weaker sort of men. In one case certainly, in which he cured a man of deafness, his princely position can hardly have helped him much, for the man was also a prince of the blood—Louis, ex-King of Bavaria. Louis's letter describing his own cure, and other wonders, is very curious. It is addressed to Count von Sinsheim. "My dear Count," he says, "there are still miracles. The ten last days of the last month, the people of Würzburg might believe themselves in the times of the Apostles. The deaf heard, the blind saw, the lame freely walked, not by the aid of art, but by a few short prayers. . . . On the evening of the 28th, the number of persons cured, of both sexes, and of every age, amounted to more than twenty. These were of all classes of the people, from the humblest to a prince of the blood; who, without any exterior means, recovered, on the 27th, at noon, the hearing which he had lost from his infancy. This cure was effected by a prayer made for him, during some minutes, by a priest, who is scarcely more than twenty-seven years of age—the Prince Hohenlohe. Although I do not hear so well as the majority of the persons who are about me, there is no comparison between my actual state and that which existed before. Besides, I perceive daily that I hear more clearly. . . . My hearing at present is very sensitive. Last Friday, the music of the troop which defiled in the square in front of the palace struck my tympanum so strongly, that for the first time I was obliged to close the window of my cabinet. The inhabitants of Würzburg have 'testified, by the most lively and sincere acclamations, the pleasure which my cure

* Dr. Todd remarks, with sly humour, that Hohenlohe's "name and titles had probably much to do with his influence. They were Alexander Leopold Franz Emmerich, Prince of Hohenlohe-Waldenburg-Schillingsfürst, Archbishop and Grand Provost of Grosswardein, Hungary, and Abbot of St. Michael's at Gaborjan." How should such a name fail! Hohenlohe was born in 1794, in Waldenburg, and educated in several universities. He officiated as priest at Olmütz, Munich, &c. "When twenty-six," Dr. Todd adds, "he met with a peasant who had performed several astonishing cures, and from him caught the enthusiasm which he subsequently manifested in curing the sick. He constantly appealed to their faith in his power."

has given them.'" Many in like manner were cured through their faith in Father Mathew (not in teetotalism, be it understood); and even after his death many who went lame to his tomb left their crutches there. It was not necessary that the patient should be of the worthy father's persuasion in religion. Many staunch Protestants were cured by him, as they supposed; but in reality by processes taking place within their own minds, and initiated by their own lively imaginations. Whether after cure such persons remained as staunchly Protestant as they had been before, I do not know.*

In a similar way may be explained (or rather must be explained, when due account is taken of the weight of evidence) many cases in which maledictions seem to have taken effect, as by a miracle. Paralysis, which has been often cured by faith, has been produced, though less often, by terror. In the *Medical Gazette* for May 23, 1868, there is a report of a singular case which occurred at the Limerick Sessions. Two men had been charged with having assaulted a relative. "The prosecutor summoned his own father as a witness. The mother of the prisoners, exasperated at the prospect of her sons being sent to prison on the evidence of her own relative, gave expression to her feeling in a malediction, praying that when the old man left the witness-box he might be paralysed, and paralysed he was accordingly, and had to be taken to the hospital. Such miraculous illness not yielding readily to ordinary modes of treatment, the old lady has been requested to remove her curse by spitting on the patient, but this she sternly refuses to do, and the man remains in the hospital." Unfortunately, the end of the story was not given. It would have been pleasing to learn that in the long run the old dame relented, and by spitting on the invalid restored him to health, for then the evidence of the influence of imagination would be complete.

Many will recall here the story of "Goody Blake and Harry Gill." Although Wordsworth calls this "a true story," yet most persons probably imagine that, as related by the poet, it is in a large degree a work of fiction. That Wordsworth himself regarded the punishment of the hard farmer as wrought by supernatural means is well known, and comes out clearly on a comparison between his poetic version of the event and the terse prosaic narrative by Dr. Erasmus Darwin in his "Zoönomia." Yet the story was true enough in all essential points as told by Wordsworth. The elder Darwin's account of the case runs simply thus:— "A young farmer in Warwickshire, finding his hedges broken and the sticks carried away, during a frosty season, determined to watch for the thief. He lay many cold hours under a haystack, and at length an old woman, like a witch in a play, approached and began to pull up the hedge; he waited till she had tied up her bottle of sticks, and was carrying them off, that he might convict her of the theft, and then springing from his concealment he seized his prey with violent threats. After some altercation, in which her load was left upon the ground, she kneeled upon the bottle" (*sic*, it is the old-fashioned word for a "bundle") "of sticks, and raising her arms to heaven beneath the bright moon, then at the full, spoke to the farmer, already shivering with cold, '*Heaven grant that thou mayest never know again the blessing to be warm!*' He complained of cold all the next day, and wore an upper coat, and in a few days another, and in a fortnight took to his bed, always saying nothing made him warm; he covered himself with very many blankets, and had a sieve over his face as he lay" (the benefit expected from this arrangement is not altogether obvious); "and from this one insane idea he kept his bed above twenty years, for fear of the cold air, till at length he died." It was unfortunate for him, by the way, that Turkish baths had not been introduced into England in his time! For probably if he had tried the radiating room of a Turkish *hammam* he would have found that even the old woman's curse did not prevent him from knowing what it was to feel warm; and once recognising this, he would have been able, perhaps, to rise above the superstitious fears to which in reality the sensation of cold was due. The commonplace curse of an old woman whom even the least censorious can hardly regard as altogether worthy of absolute veneration, and who had probably exchanged some rather coarse abuse with Gill in the preceding "altercation," is rather amusingly changed by Wordsworth into a solemn appeal to heaven by a much-injured victim (after all, it must be remembered that Gill had not hurt the old woman, and that a farmer has some right to complain when his hedges are broken and the sticks removed):—

Then Goody, who had nothing said,

(having, it should seem, very little to say)—

Her bundle from her lap let fall;
And kneeling on the sticks she prayed
To God, who is the Judge of all;
She prayed, her withered hand uprearing,
While Harry held her by the arm—
"God! that art never out of hearing,
Oh may he nevermore be warm!"
The cold, cold moon above her head,
Thus on her knees did Goody pray;
Young Harry heard what she had said,
And icy cold he turned away.

Probably we may refer the effect of her malediction rather to her appearance—as described by Dr. Darwin, "an old woman like a witch in a play"—than to the solemnity of her prayer. He believed, in his sudden fear, that she was a witch, his imagination attributed to the witch's curse the cold which naturally enough resulted from his long watch on a bitter cold night, and his fears thus seemingly confirmed so influenced his imagination thereafter, that he experienced the constant sensation of cold described by Darwin. That the actual temperature of his body was also affected may well be believed. For it is well known that persons whose minds are affected undergo a loss of temperature. "In *mélancolie avec stupeur*," says Dr. Ertzbischoff, "the temperature is always below the normal amount." But it is certain the actual loss of heat cannot have been even nearly so great as the apparent, for, if it had, Gill would certainly not have lived twenty years.

I could cite many other illustrations of the influence of the mind, whether stimulated by emotion or by expectation, on the body and its functions; but I have already exceeded the space which I had intended to occupy. Let it suffice now to call attention to the extreme importance, both in a physiological and in a psychological aspect, of the recognition of this influence, and the necessity for more careful and systematic study of its nature and limits than has yet been made. It was said sneeringly by Dr. Elliotson, who was a believer in the mesmeric or preternatural interpretation of effects now demonstrated to be due to imagination only, that if Mr. Braid, Dr. Carpenter, and Dr. Holland

* I was told a few months ago by a worthy, simple-hearted Irish priest, that he was sent for on one occasion to administer the sacrament of extreme unction to a Protestant lady, who (not knowing that Catholicity was an essential preliminary) hoped to find in the sacrament a cure for an attack of inflammation of the bowels, which the doctors had in vain attempted to assuage. They hourly expected her death. Finding no other course open to her, she "made submission," was received into the Church, and the sacrament of extreme unction was administered. When next the family doctor called the lady was well, save for the state of weakness to which many hours of extreme pain had reduced her.

could ascribe the actual extirpation of certain bodily matter to dominant ideas, suggestion, and expectant attention, they "ought to petition for the introduction of these into the next 'Pharmacopœia' of the Royal College of Physicians." "We do make this petition; or at least," says Dr. Tuke with excellent judgment, "let these psychical agents be included in the *armamenta medica* of every medical man." But not alone with reference to the cure of disease have these experiences interest and value. Rightly apprehended, even now when they are incomplete, they throw much light on the qualities and functions of the brain. But if the study of such cases were carefully and sedulously pursued, observations and experiments being multiplied, as they well might be, I believe that some of the most difficult problems of mental physiology would before long be interpreted, and that mental powers as yet unsuspected would before long be revealed.

CLOTHES MOTHS.

By E. A. Butler.

In previous papers we have studied the household representatives of the first two orders of insects, the Coleoptera and Hymenoptera; we may now pass to the third, viz., the Lepidoptera, or butterflies and moths. The insignificant but abominable pests referred to in the heading of this paper will be at once recognised as very familiar examples of this order. The term clothes moth, however, like most popular names, is a vague and indefinite one, and in most cases it is not easy to say what insect really is meant when the term is used. Any small moth found indoors usually gets branded with this opprobrious epithet, which is thus applied indiscriminately to several species, to some justifiably, to others the reverse. There are at least half a dozen kinds of small moths that regularly and more or less commonly take up their abode with us, but while some of them are indeed fearfully destructive to woollen and other animal stuffs, others are either general feeders or depend for their sustenance upon various vegetable substances, and, as a rule, probably do no harm to our clothes at all, and it will be our business here to endeavour to discriminate carefully between these different insects.

The term "moth" itself even is but a vague one, for it is the only popular designation for a great variety of insects differing considerably in structure and habits; and to get a clear and accurate notion of those that inhabit our houses, and of their relations to one another and to the other members of the group, it will be necessary first to say a few words about the order Lepidoptera in general.

It will be remembered that the word Lepidoptera means "scale-wings," the scales being that mealy powder which constitutes the colouration and pattern of the wings above and below, and which in one form or other is found in all species of the order, and may be regarded as characteristic. Now in the first place this large order may, for convenience sake, be roughly, though not very scientifically, divided into two great groups, which are known as the Macro-Lepidoptera and the Micro-Lepidoptera, i.e., the "great" and "small" Lepidoptera. For brevity's sake these long names are usually curtailed to Macros and Micros respectively. In the former group are included the butterflies, and the majority of the more conspicuous and familiar of the insects called moths—all those insects, in fact, which are sought after so eagerly by the majority of "butterfly-catchers." Most of them are of tolerably imposing proportions. The latter group, on the other hand, few people, except those who specially study them, know or care anything about, the reason for this neglect being merely the small size of the majority; to be small is often to be despised, and so the Micros get scant attention, even from professed collectors. Yet it is to these despised Micros that our household moths belong, so that, economically at least, some of them are of considerable importance, and ought to be of corresponding interest.

A few of the Macros often choose our houses to hibernate in, but the members of this group do not as a rule court our society; the chief inducements for them to enter our dwellings are an open window and a brightly shining lamp within, and then in suitable localities they will enter in great numbers, and sacrifice themselves on the funeral pyre. But these are, of course, but chance visitors, and none of the Macros can be regarded as permanent residents with us, propagating themselves as the Micros do, generation after generation, without ever visiting the outer world.

The Micro-Lepidoptera are subdivided into some five or six very distinct groups, to two only of which, however, our strictly household species belong; these two are called the Pyrales and the Tineæ. The former of these, which are placed at the head of the Micros, are amongst the largest of that group, most of them, indeed, being (notwithstanding the names) larger than the smallest of the Macros, and they can usually be readily recognised by their rather pointed wings and their long slender bodies and legs; it is to this group that, in the articles on the "Entomology of a Pond," published some months ago in this magazine, we referred those beautiful little water-moths, the China-marks, and to it we must now refer the household species known as the Meal Moths, and the Tabby, or Grease Moth. The Tineæ, which may be regarded as some of the lowest of the order, are a very large group of exceedingly varied and interesting habits, and remarkable as containing the smallest of all Lepidoptera; they usually have long, narrow wings, edged with deep fringes, and to them belong the true clothes moths, together with several other insects that make themselves obnoxious to the careful housekeeper in other ways than by attacking furs and woollen garments.

The Tineæ, as containing the more familiar insects, may profitably first occupy our attention. This section numbers about 700 British species, and our household pests belong to several genera scattered throughout this host. The clothes moths, however, are all members of one genus, *Tinea*, which contains about thirty British species, of which only a very few trouble us indoors; the rest feed upon lichens, bark, &c., and are therefore found in the open country. The word Tinea is the Latin name for the caterpillar of a clothes moth; in other words, the Romans applied this name to any grub-like insect that damaged clothes, &c., whatever, according to our modern notions, the species might be. Pliny speaks of "a certain Tinea, which is capable of hanging by a thread, or is clad in a jacket, gradually forming for itself its own garment, like a snail its shell, and when this is taken from it it immediately dies; but when its garment has reached the proper dimensions, it changes into a chrysalis, from which, at the proper time, a little moth issues." It was natural, therefore, that this term should be adopted by modern naturalists as the generic name for the insects that possess the above-mentioned habits; and it is from this genus *Tinea* that the whole section derives the name Tineæ, or Tineina, though it is far from being implied by this that the whole group are the foes of textile fabrics. The word, therefore, has nothing to do with our English word "tiny," though it so happens that members of this group are the tiniest of the whole order.

At least four species of the genus *Tinea* are included

under the general name clothes moth, i.e., as attacking some kind or other of animal fabric. They are *T. pellionella, biselliella, tapetzella*, and *rusticella*. As the habits of these are somewhat different, it will be necessary to treat of the species separately.

And first as to *T. pellionella*. This is a little creature about half an inch in expanse of wings. Its fore wings are of a shining greyish yellow colour, with three indistinct brownish spots in the middle, and the hind wings are whitish grey. It is an abundant species in houses, and may be found at any time between January and October, though most abundantly in the early summer months. Of course the moth itself is innocent enough; it is in the larval state that it does all the damage to clothes, furs, feathers, &c. The larva is a tiny caterpillar, dull whitish, with a reddish brown head. It is remarkable as being the only one of our four clothes moths that makes a tunic or moveable case for itself, protected by which it roams in search of congenial food over our stores of unused and undisturbed garments. Muffs, tippets, and other fur garments it particularly delights in, and many are the valuable furs it has altogether ruined, not so much by the actual quantity of hair devoured, as by the amount it has snipped off and wasted.

The case is most ingeniously constructed; it is made of two materials: an outer layer of fragments of the fabrics that have formed the little creature's food, and an inner layer of silk, which forms a beautifully soft and smooth lining, and is secreted by the caterpillar itself in a manner similar to that in which the silkworm forms its well-known cocoons. It is nearly cylindrical in form, but of slightly larger diameter across the middle, and a little flattened above, and is open at both ends; when crawling or feeding, the little inhabitant thrusts out of one end its head and the three segments of the body behind it, these being the ones that carry the three pairs of legs by which locomotion is effected. As it proceeds on its way it keeps this anterior part of the body exserted, and holding on to the silken lining of its case by its claspers, which are situated towards the other end of the body, drags its house along with it. If danger menaces, it retires completely into its case. The cases are of course very varied in appearance; from the method of their construction it is manifest that their colour will depend upon that of the material upon which the insect has been feeding, and by judicious variations of its dietary the little tailor can be induced to form cases of all conceivable tints, or mixtures of such.

The method employed for adapting the case to the needs of the growing caterpillar is truly marvellous. It is obvious that two kinds of enlargement will be necessary; with the growing stature of the larva the case will need elongation, but it will require an increase in circumference as well; and though the meeting of the former demand presents no difficulty nor necessitates the exercise of much sagacity in the device of a method, the latter might well be the subject of considerable perplexity, and one is scarcely prepared for the extreme ingenuity manifested by the little creature in meeting the difficulty. When it finds its quarters becoming too strait it slits up the case on one side for half its length by means of its scissor-like jaws, and fills up a certain space between the severed edges with the same materials as compose the rest of the case. This done, a similar slit is made, say, at the other end, and the like process gone through again. Though the circumference is now increased throughout, this is not the end of the operation, for the new pieces having been let in only on one side the case thereby becomes a little unsymmetrical; therefore to restore the symmetry of its form two precisely similar operations are carried out on the other side, so that to complete the process no less than four slits have to be made—two at each end—and to be successively filled up with the usual materials. It would appear, however, from the observations of Réaumur, that the insect does not always observe the same order in making these slits, but may vary the order indefinitely.

To lengthen the case all that is necessary is to add successive rings of silk and woollen fibres to the ends, but even in this simple operation there is a choice of methods, for the addition might be made at one end only or at both; the latter device is the one adopted. First of all a ring of new material is added at one end, to effect which the grub does not need to leave its tunic, the whole operation being able to be performed from the inside; a layer of silk is spun out in the form of a continuous thread, and then a number of tiny fillets of the woollen fabric, or fur, are attached to its outer surface by other silken threads. This done, the caterpillar, still without quitting its shelter, rapidly reverses its position, bringing its head into the position previously occupied by its tail; the extreme flexibility of its body, and the rather wider diameter of the case in the centre, enable it to do this very quickly; then the same addition of a ring of felt is carried out at the tail end, and in this way the case is elongated equally at the two ends, and what was originally the middle always remains such, and therefore the oldest part is always to be found in the centre and the newest at the ends.

When the grub is full fed, it must set its house in order and prepare for the helpless condition which precedes its final metamorphosis. The chrysalis state is assumed inside the case, the caterpillar becoming, by throwing off its last larval skin, a little yellowish brown helpless thing, similar in form to the well-known chrysalis of the larger moths. Now a danger has to be guarded against; the insect has to remain some weeks in this state of inactivity, and if the case with its precious freight were simply left lying on the cloth as usual, any moving of the latter might cause the little bundle to roll off and fall no one knows whither and into one knows not what perils. To guard against such a catastrophe, the caterpillar, when it feels the inward promptings which are prophetic of its approaching change, spins some fine silken threads from the ends of the case, and attaches them at their outer extremity to the cloth on which it has been feeding, thus as it were casting many anchors out of both bow and stern of its little boat; its fate is in this way linked with that of the larger object, and a much greater degree of security is thus ensured. Very frequently, however, it altogether forsakes the cloth, and chooses some retired corner or crevice in which to anchor its little craft. Thus all through the three weeks of waiting for its wings it lies in its case, like a mummy in its sarcophagus.

At length the time arrives for the final change. The chrysalis, by the aid of sundry little spines arranged in transverse rows along its back, one row on each segment, works itself along till it reaches the end of the case, and then the imprisoned moth, bursting its chitinous covering at the head, gradually extricates itself from its cerements, which it leaves half projecting from the now useless sarcophagus. The cast chrysalis case forms a very pretty microscopic object; it is almost transparent, slightly tinged with yellowish brown, and shows distinct cases for the antennæ, which clearly present slight constrictions corresponding to the multitude of joints of which the organ itself was composed. It also very plainly shows the hooks along the back, and those on the terminal segment are seen to be the largest and most powerful. On its first exclusion from the chrysalis, the moth's wings are very small and soft, but after a while they expand until they have reached their normal dimensions, and acquired their normal consistency.

Now the little being is ready for the fulfilment of its mission, the propagation of its species. Its methods of

locomotion are twofold; with its four glossy and beautifully fringed wings it can fly tolerably well; but with its six long-jointed legs, it can also run rapidly, carrying its wings close alongside its body, and vibrating its antennæ with an incessant tremor indicative of the excitement which now thrills through its little frame. It needs no food, and indeed there is probably nothing within reach that could serve it as such; for the gross aliment which delighted it when a grovelling grub, possesses no charms for it in its higher state of existence, and indeed, were its tastes to tend in that direction, it could not gratify them, for, like the rest of its order, it has no jaws wherewith to reduce the tough fibres of cloth, and even the usual flexible maxillæ, the two long coils which form the sucking apparatus of moths for imbibing honey, are present only in a rudimentary condition, as is the case throughout the genus *Tinea*. Its sole business, therefore, is to get mated, lay its eggs and die.

As might be expected, the eggs are extremely minute, and they are carefully deposited by the mother on the cloth, or in crevices and corners close to a supply of food. The young grubs hatched from these soon manifest their tailoring propensities, but they seem, at this early stage, to prefer second-hand garments, or rather shoddy, to an entirely new "rig out." In other words, they attack the old cases of their progenitors, which are sure to be lying about in plenty, and by cutting up these larger garments, manage to make some respectable coverings for their own tiny forms; the filaments of wool and fur which have been submitted to the action of the more powerful jaws of their adult ancestors, are in a more manageable condition for the weaker weapons of the juveniles than would be those of cloth that had never undergone such a preparatory process.

Tinea pellionella is one of the commonest and most destructive of our clothes-moths, and is especially partial to furs and feathers; its attachment to the former is indicated in its name, which is derived from the Latin "pellio," a "furrier." It is sometimes therefore called the fur-moth. Its larva has also been known to feed on cobwebs.

Our other clothes-moths must be left till the next paper.

(*To be continued.*)

COUNTING UNCONSCIOUSLY.*

By Professor W. Preyer, of the University of Jena.

AT first sight the superscription, "counting unconsciously," seems to contain a contradiction. For whoever counts from one to one hundred realises at each number that he is counting; yet, in truth, there are so many instances where an educated person counts without realising it that he would feel utterly lost in this world should the faculty be suddenly taken from him.

Three coins being placed on a table, any one will, on being asked, "How many are there?" answer, after but a glance, "three." Even when four or five coins are seen but for a moment the answer as to their number will be correctly given. So quickly is the answer returned that no time can possibly have been taken for counting. Hence it follows that counting unconsciously is really an everyday occurrence. The objection that this is no longer to be termed counting is not valid, for if anyone can positively state that there are lying before him three, or four, or five objects he must be able to distinguish numbers; and it is certainly a fact that one who cannot count can also not answer such questions. Children, in order to distinguish three marbles from four, must first add each marble to the other; in this way many learn to count before knowing the numerals. From this it follows that in order to count a knowledge of the numerals is not a necessity; even untrained deaf mutes, who can neither read nor write, are capable of counting, without figures, merely by the aid of their fingers.

From the action of a child who has learned the meaning of the numerals it furthermore follows that it is only by practice, that is, by oft-repeated counting of actual objects, that surety is gained in the art of counting small numbers unconsciously. An idiot, or whoever does not practise, cannot count three without adding one by one, and will never rise above the lowest plane of mental development.

Now, however, as is well known, no one can tell in a moment how many objects are lying before him, provided the number of these objects is somewhat large—approximates, say, fifty. Some persons can count more rapidly than others: a broker's apprentice will make groups of three, of five, of ten coins, and then add the groups together; the experienced money-broker is able to determine in a few seconds what the amount is, and this, perhaps, without even touching the coins. But he too, as well as everyone else, must count attentively as soon as the number of pieces exceeds a certain limit. But what is this limit?

Dase, the well-known calculator, who died in 1861, stated that he could distinguish some thirty objects of a similar nature in a single moment as easily as other people can recognise three or four, and his claim was often verified by tests. The rapidity with which he would name the number of sheep in a herd, of books in a book-case, of window-panes in a large house, was even more remarkable than the accuracy with which he solved mentally the most difficult problems. Not before or after his time has such perfection been attained; but as everyone possesses this faculty to a small extent, and, as it can be improved by practice, it is not impossible that in future other experts in this line may appear. The only trouble is that so few know how easy it is to practise.

In the first place one can by a few trials readily gain the conviction that, without practice, not everyone can distinguish six and seven objects as easily as three and four.

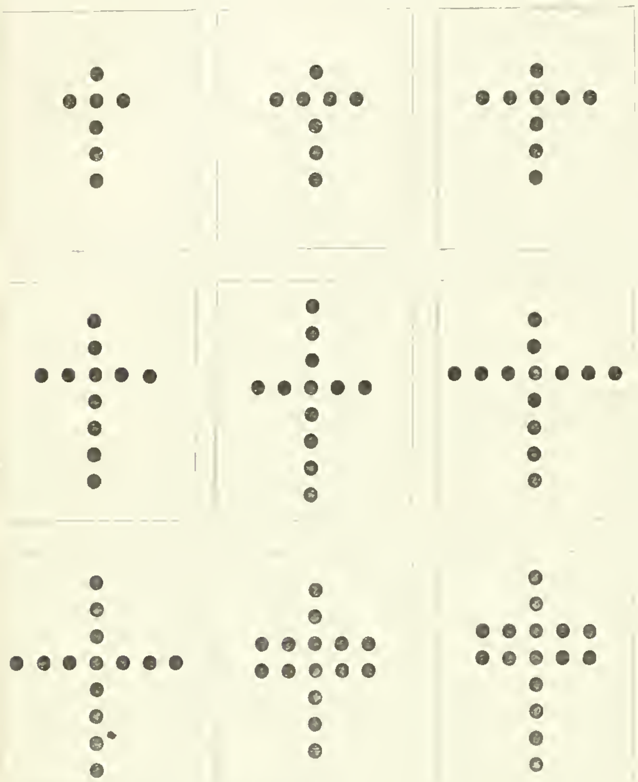
In order to learn that it is a comparatively easy matter to estimate up to six and seven, and then up to nine, as correctly as from three to five, one need only make a few trials in guessing at an unknown number of matches or pins that are concealed beneath a sheet of paper, and are then exposed to view but for a second.

Great care must be exercised, however, that one does not consciously count in these attempts, nor will it answer to attempt analysis from memory after the objects are again hidden from view; all this would consume too much time. It is, in fact, necessary to do nothing more than to *estimate*, but this must be done with the utmost attention.

Whoever has for any length of time tried seriously to guess correctly will be surprised to find that his guesses will soon grow to be generally correct, whereas at the start they were often erroneous. Only when the number of objects seen exceeds nine will mistakes again occur more frequently. However, further practice in estimating greater numbers of small objects will soon cause considerable improvement even here. Many, however, do not succeed in estimating correctly beyond ten, probably because the attention is not sufficiently concentrated at the time, and as it is necessary, at the start at least, that one's whole attention be closely given; only after having attained some

* The experiments suggested here would afford capital amusement as parlour games—having also the advantage of being useful and instructive.

degree of proficiency will the exercise of this power no longer prove fatiguing.



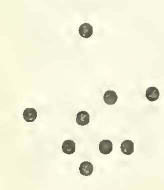
In order to practise this kind of counting, dots and small circles were drawn on white paper squares. Some of these dots were arranged symmetrically, others were irregularly placed. These were glanced at for a moment, and proved of considerable aid in acquiring the art. A good deal depends on the arrangement of the dots. A card-player will immediately, and without stopping to count, realise that there are ten hearts on a ten-spot of that suit, but he will not be able to give as correctly the number of hearts or of dots if these be arranged, for instance, in the form of a cross.

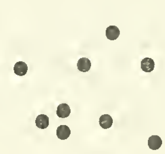
Hence it follows that it is not the symmetry of arrangement that facilitates the estimating, but acquaintance with the manner of arrangement used.

It is more difficult to correctly estimate the number of dots arranged in the form of a cross than to determine them if arranged as on cards and in similar ways.

It is more easy to estimate the dots if arranged as on dominoes; the dots must not be too small, and must be made a deep black on a white ground, or the reverse.

The estimation of the number of dots is most difficult if they are grouped in an irregular manner, as, for instance, in the following figures:—





Practice, which is nought but patient and correct repetition, will, however, even here make perfect. However, it may be regarded as proved by the case of Dase, before referred to, that practice, however long continued, cannot aid beyond a certain limit. It seems that, for the rapid estimation or the unconscious counting of dots placed in unknown symmetrical arrangement, and for objects grouped into irregular forms, twenty is the limit.

Probably already, when the number of the objects exceeds twenty—undoubtedly, when it exceeds thirty—accuracy in estimating can no longer be attained, even after the greatest amount of practice, in which Dase for one certainly was not wanting.

However, this is not to say that more than thirty dots cannot, under any circumstances, be simultaneously determined; but in order that this may be done they must be presented in some well-known manner of arrangement, which must, as it were, have been fairly learned by heart. Thus, very skilful card and domino players are able at a glance to take in as many as forty points, in nines, tens, fives, sixes, &c. This they do so rapidly as not to be conscious of any addition. But in such cases it is no longer the seeing of single dots, but seeing the pictures they form, which makes the feat possible. As no one on seeing the number 8 will count from one to eight, so no card-player will stop to count on seeing an eight of hearts, for instance. A child, however, not yet familiar with the appearance of cards, will count each heart separately, perhaps even touching each one in turn with his finger.

In order to quickly attain the faculty of counting unconsciously, a book may be used to advantage. If one takes a book, opens the same—the eyes to be kept closed in the meantime—and then casts a rapid glance at a part of the page and tries to estimate how many lines are visible, this way of doing, if often repeated and always tried on different pages, will soon conduce to great accuracy in estimating. A small child is not able to estimate even three lines correctly, though looking at them for fully a second.

As the mind develops, it acquires a more simple and rapid process of counting. Something that at first had to be undertaken slowly and with care, perhaps in separate stages, may later on be accomplished much more quickly and without requiring any special effort or calling for any great amount of attention, in fact, almost "mechanically."

One is fully conscious of every perfectly new impression received by the brain; hence the fascination of a novel idea. The more the charm of novelty fades with the recurrence of the same sensation, the less will consciousness be called into play.

An impression that seemed most startling when first received may, if too often repeated, grow to be trivial. The simple work of counting finally comes to be an unconscious action of the nerve-fibres and cells of the brain.

On newly-built roads the trains are run but slowly; the longer such roads have been used the more rapidly are trains run on them, and stops at way-stations are no longer needed; it is even thus with the trains of thought in the human brain.

And on this rests the practical importance of rapid counting. Whoever can, unconsciously but correctly, count up to twenty, or even up to twelve, has a great advantage over others who cannot, without error, distinguish six from seven in this manner. For such a one can turn his consciousness to other matters, and greatly increase his knowledge, where another would make but slow progress.

Those movements in man, which take place through some impression received from without, and not aided by any conscious act of the brain (as, for instance, the contracting of the pupil when a bright light strikes the eye), are termed reflex actions.

In part these are brought about by arbitrary but oft repeated motions, inasmuch as such will gradually take place more rapidly and without premeditation.

In this way, through practice, counting from one to five is done unconsciously, and somewhat resembles a reflex action.

If many such simple mental acts (by the repetition of which nothing new is learned, and time only is lost) could be caused to pass off more rapidly—somewhat resembling reflex actions—the brain would be left free to turn to other, to higher aims.—*Translated for the "Popular Science Monthly" from "Die Gartenlaube."*

THE NATURALIST'S LABORATORY.

Contribution II.

THERE are many items of importance to be attended to in the choice and arrangement of a special apartment for laboratory work that are apt to be overlooked by the majority of ordinary students, so that a few words here upon the subject will not be out of place.

First of all, with regard to light, pure diffused daylight is unquestionably the best, and the window or windows ought therefore to face the north, and command, if practicable, a wide expanse of sky. The room need not be a large one, but, whatever its size, every part ought to admit of being perfectly lighted during the hours of sunlight, so as to allow the most perfect inspection at any time. But, since a clear north light cannot always be commanded, some efficient provision should be made to modify the direct rays of the sun which will then enter through the ordinary panes of window glass, the transparent, colourless material of which may be replaced by translucent ground glass, opal plates, or covered over with a film of white paint or whitewash solution. A ready expedient can be adopted by interposing a screen of white tissue paper or muslin; but these last ought to be removed and frequently cleansed, since they are very apt to harbour dust, and may unexpectedly interfere with the operator's work by an unlooked-for shower at any time. For similar reasons carpets, rugs, and curtains must not be admitted. By following this advice strictly, pure diffused daylight, only slightly inferior to an uninterrupted northern light, will be obtained, and nought can interfere to damage the student's most delicate work.

The window was originally constructed to act as a ventilator in ancient times—it was a *wind-door*; but nowadays the advances that have been made in architecture show that its true function is to *light* the apartment during the daytime, and to act as a ventilator only in a subordinate way. Although professional architects are cognisant of these facts, the greater number of houses in this country are not built under their supervision, and are hence very imperfectly constructed; so much so that the windows are left to perform a principal duty in letting fresh air into the house. It is thus highly probable that many persons may find their chosen *sanctum*, with its north light, subject to violent draughts, with their accompaniments of dust and dirt, aggravated by occasional puffs of smoke from the fireplace during the colder periods of the year. To correct all this would be a great boon to the worker, for it would place it in his power to at once free himself from his worst enemy,—suspended dust,—and to derive much personal comfort during his labours. We shall show in the sequel that the remedy is not only extremely simple, but inexpensive.

The atmosphere of inhabited rooms differs from the normal fresh air both chemically and physically. The products of combustion and respiration attendant upon life and its surroundings—fireplaces, lamps, gas, &c.—tend to vitiate the air and render it eventually quite poisonous. But although the density of the principal pernicious product, carbon dioxide ($CO_2=22$ when $H=1$), is greater than that of the principal gases of air—viz. oxygen and nitrogen ($O=16$, $N=14$), yet the contaminated air rises to the upper region of the room in virtue of the higher temperature with which it is endowed by its generators, the fire, gas-flame, and the lungs. As soon as it reaches the ceiling provision should be made for its expulsion, otherwise it will have time to cool, descend, permanently pollute the air, and give rise to lassitude, sick headaches, and a general disinclination for work. No doubt this could be remedied by opening the window slightly both at the top and bottom, but such a procedure would not be likely to suggest itself during a cold wintry day, and in warmer weather would admit extraneous dust and dirt. Hence, if no special provision is made for the escape of the foul air, it will descend and make its exit partially through the chimney vent, but not until the conditions of pressure within and out of doors have been so considerably altered that a forced draught is caused through window chinks and beneath the doors of the apartment.

Efficient ventilation thus should provide for the extraction of the vitiated air at a point of vantage, and for the equalisation of pressure (to prevent draughts) by an inlet for fresh air. Appliances without number have been invented from time to time to meet these wants, but in every case attention must be paid to the size and position of the apartment to be ventilated. As a rule, however, it will be found that for a moderate-sized room one outlet for vitiated air will be sufficient, and that should be placed in or near to the ceiling. The form known as "Boyle's Mica-Flap Outlet Ventilator" should be fixed in the breast of the chimney immediately beneath the cornice. The ventilator consists of a metallic box with an open grating in front. Behind the grating are suspended usually four valves of mica, which are practically indestructible, light, and rigid; they are so sensitive that they open with the slightest appreciable up-current in the flue, and immediately close against down-draughts, so as to effectually prevent the smoke from entering the room. As a rule, the up-draught of the chimney is sufficient to extract the foul air through the mica-flap ventilator, but, to make things doubly secure, a chimney cowl should be placed at the top of the flue. The action of the latter is to draw up the air in the chimney, and those constructed upon the passive principle are, without doubt, the best. The slightest gust of wind over the chimney-top induces a vacuum in the head of the cowl, and the foul air is thus effectually sucked up, as it were, and expelled at a part where it cannot do any harm.

A more perfect plan than that just detailed above would involve a well-regulated system of ventilating pipes throughout the house: a special pipe leading from the ceiling of each apartment to an extracting ventilator on the roof, independent of the fireplaces and chimneys. Such a system need not be expensive; indeed, it comes within the easy reach of the poorest class of persons, for there are now firms who make it their business to supply all the requisites for efficient ventilation of houses or of isolated rooms at a very small cost. A case in point is noted in *The Architect* for August 16, 1884 (pp. 100, 101), where the writer says respecting the thorough ventilation of a workman's cottage of about four rooms:—"It may be frankly stated that Messrs. Boyle do not submit this system with any expectation of deriving a profit from the manufacture. It is introduced simply for the benefit of the working and poorer

classes. The following description will suggest the amount of material and labour on one of the ventilators:—One 16-inch diameter 'Boyle's Patent Self-acting Air-Pump Ventilator,' made of galvanised iron and painted; $1\frac{1}{2}$ foot of 8-inch pipe, with dividing plate; 30 feet of 5-inch diameter pipe, 8 feet of 4-inch pipe, two 5-inch junctions, two 5-inch knees, two 5-inch flanges, two 4-inch junctions, two 4-inch knees; four air-inlet brackets, 10 inches by 5 inches by 3 inches. When it is said that all the above will be made of strong galvanised iron, and will cost only four guineas complete, it will be plain that there is no charge for anything beyond the net cost of materials and workmanship. A plan and printed instructions are supplied along with each set of appliances. The system can be applied to tenements at the same rates, every room in the largest block being ventilated separately. *It can also be applied to existing buildings at a trifling extra expense.*

It thus appears that one need not be at a loss nowadays to ventilate a room or a house perfectly and at a small cost. But to return to the subject of admission of fresh air into the room. It should be freed from particles of dust and dirt, should not cause a draught, and should be capable of being warmed or cooled at pleasure. All these desiderata are found combined in many of the inlet ventilators now in the market, such as those of Messrs. Boyle, Lamb, Ellison, and others, and may be adjusted by any ordinary workman with ease. With inlet ventilators one should be careful to select such a position in the apartment as to enable it to work in conjunction with the outlet, and it is in addition advisable to supplement it by adding a closable ventilator to each window, as in Verity's *Multum in parvo* window, where ventilation of the room is assisted by a frame which gives a maximum of light, is burglar and weather proof, and, since it can be turned completely round, may be cleansed from within the room. All these things taken together point it out as the window *par excellence* for the naturalist's laboratory.

Another thing of importance about the structure of the student's room is that the doors should fit so well as to prevent the incursion of dust particles. Now, nearly every door is apt to warp or the threshold to wear away, so that in time a patent space remains beneath through which quantities of dust may enter. This may be prevented by affixing to the base of the door an appliance called "Warhurst's Automatic Dust, Draught, or Rain Excluder." It consists of a movable pad, which rises when the door is opened, and is depressed upon the closure of the latter in such a way as to give perfect contact everywhere with worn, wearing, or uneven thresholds.

Gossip.

By Richard A. Proctor.

It has been our wish, since Knowledge was started in 1881, to give readers more than any other magazine of the same nature has supplied at the same price, and also to make an opening for original interpreters of science on fair, or rather on generous terms. We knew well that competition with the story-telling magazines, which ensure a wide circulation by serial novels or by short narratives, would be useless, so that we could not hope to compare columns with the *Cornhill*, *Longman's*, and similar magazines. Nor, on the other hand, did we expect to provide the same amount of material per shilling as the *English Mechanic*, and other similar magazines intended chiefly to meet the special wants of large classes of working men. But comparing with other journals which have the same general character or scope as this one—the *Popular Science Monthly* in America, *Nature* in England, the *Revue d'Astronomie* in France, &c.—we hoped to be able to give more matter, and especially more original matter. Comparing even with such magazines as the *Contemporary* and the *Nineteenth Century*, we hoped to remain ahead in this respect.

* * *

So far, we have achieved our purpose, and (especially of late) with growing support of an encouraging nature. But it has been at the expense of making every number of Knowledge more or less of a gift, and by allowing paid contributions to be the only fully paid portion of our work. Every week the editor has had to provide, by work outside Knowledge, for the extra expenses which a too generous system at starting had involved. After five years on these lines, and finding the time still far off when our growing constituency will pay the expenses of publication, we find it desirable—nay, absolutely necessary—to take in sail, hoping that the favouring breeze of popular support will not cease therefore to waft our bark outwards. We still carry more sail than other craft of the same class. For example, taking those above-named in their order, the comparison will hereafter run thus (taking in each case the supply of matter per sixpence of prices):—

Popular Science Monthly	36 cols., averaging 500 words
Nature . . .	48 cols., averaging 600 words
Revue d'Astronomie .	20 cols., averaging 450 words
XIXth Century & *Contemporary Review*, not illustrated, each .	36 cols., averaging 500 words
Knowledge, from now .	48 cols., averaging 700 words

* * *

We trust our readers will recognise the fact that we have done and are still doing the best we can. With regard to the scope and purpose of Knowledge, we have an object far higher (to our thought) than the mere interpretation or explanation of scientific matters. This object is aimed at specially in such papers as those on the Story of Creation, the Unknowable, and the like. But for the opportunity of suggesting such teachings from nature as are sought to be conveyed in these papers, Knowledge would not be continued at all. *The great lesson which the recent progress of science teaches is the universal prevalence of law and the consequent futility of lawlessness, no matter under what high or seemingly sacred names it may be disguised.* This lesson we wish Knowledge consistently and persistently to teach, for of all lessons yet taught mankind this is the most valuable. Other teachings in our pages are but such accessories as have appeared desirable to secure the stability of the Journal from the publishing point of view. Among these must be considered the cheapness at which we formerly aimed. This we have to forego or rather to reduce. The change has, indeed, been too long delayed, and would have been made much earlier had we earlier had such full information respecting expenses and proceeds as we obtain under the present publishing arrangements. If our readers, mistakenly supposing that we are dealing unfairly by them, should desert us, Knowledge will simply cease to exist. Should they, as we hope, stand by us, Knowledge will go on without loss (at any rate) to the proprietors. Should they, however, help to increase and extend the circulation of our Journal, as they readily may, we shall hope to return hereafter to our former dimensions. So long, however, as that would involve a monthly loss, it would be folly to continue the attempt.

* * *

Our columns are not, as a rule, open to charitable appeals, but we make an exception in support of a movement to purchase an annuity for Mr. J. B. Dancer, the well-known optician. He was not only one of the first to stimulate microscopy by the manufacture of excellent instruments at a moderate price, but has by his skill and self-denying labour effected important improvements in optical and electrical apparatus; indeed, a long list of inventions stands to his credit, but, unhappily, not a big balance at his bankers, for in his old age he is a poor man, and after giving us eyes to see with, is himself afflicted with almost total blindness. The leading scientists of Manchester are on the committee formed to aid him, and the manager of the Manchester and Salford Bank in that city will thankfully receive subscriptions. We strongly commend the case to the readers of Knowledge.

Reviews.

The Cruise of H.M.S. Bacchante. 1879-1882. Compiled from the Private Journals, Letters, and Note-books of Prince Albert Victor and Prince George of Wales: with Additions by John N. Dalton. Two vols. (Macmillan & Co.)—These stately and sumptuous volumes embody the journals and letters of "Queen Victoria's piccaninnies" (as the West Indian negroes called them), during their three years' travel by land and water, in which the only important exceptions to places visited were India, America, and New Zealand. Mr. Barlow—we beg pardon, we were thinking of "Sandford and Merton"—Mr. Dalton, under whose charge the princes were placed, has made considerable additions to the text, which are indicated by brackets, and but for these it would be extremely difficult to distinguish his work from that of his royal pupils, which at least presumably says something for their literary skill. The sketches of life on board, with its routine and diversions, and of impressions of visits on land under the guidance of experts and the fierce light that beats on princes, have a good deal of freshness about them, and are indeed much above the average of letters sent home by boys to their parents; while the opinions expressed upon Imperial and Colonial subjects give evidence of observation and intelligence which augurs well for the future of young men destined to high functions of State. The section on China, to which Mr. Dalton has added explanatory notes on Confucius and his system, should be read in conjunction with Miss Gordon Cumming's book for its supplemental description of the system of competitive examination; while in that on Japan, where the princes were the guests of the Mikado, we get glimpses into court life. But it is impossible to follow the travellers in detail through 1,500 closely-printed pages, and it must suffice to say that they have, under their tutor's editorial care, given a brightly-written and sensible account of the many lands and peoples visited. Instead of unwieldy maps we have inset charts of the course from port to port, which it was the duty of the princes as midshipmen to prepare, and the routes are thus made easier to trace. But it is discreditable that a book so full of multitudinous matter should be issued without an index.

The Naturalist's Diary: a Day-book of Meteorology, Phenology, and Rural Biology. Arranged and Edited by Charles Roberts, F.R.C.S., &c. (London: Swan Sonnenschein, Le Bas & Lowrey.)—Mr. Roberts, in the novel form of work before us, has rendered a real service to all who may wish to derive that perennial pleasure inseparable from the intelligent observation of rural phenomena. Hundreds of valuable observations are lost through the absence of any well-defined system of making them, and it is to set forth a definite plan for the observer that this very useful Diary has been compiled. It gives the mean temperature, barometer, rainfall, wind, &c., at a selected station, for comparison with those observed in the reader's own locality; furnishes an exhaustive list of British plants and trees, with a practically complete fauna; directs the observer what to look for and when to look for it; and, in fact, supplies all the information necessary to render the various classes of observation of which it treats of real scientific value. Any one who will conscientiously fill in the spaces in this volume devoted to local records, will find by the year's end that he has accumulated a mass of information of real and permanent importance and weight. There used to be a series of works published under such titles as "Every Man his own Butler," &c. Mr. Roberts's volume may be succinctly described as "Every Man his own White of Selborne."

The Mystic Voices of Heaven; or, The Supernatural revealed in the Natural Science of the Heavens. By An Oxford Graduate. (London: Elliot Stock. 1886.)—What Professor Drummond attempted to do, in a more or less scientific spirit, in his "Natural Law in the Spiritual World," the author of the volume of sermons before us essays to accomplish in what, for want of a better word, we may term a rhapsodical one. The "Oxford Graduate" has apparently devoured books on popular astronomy of all shades of authority and value, and has attempted to correlate the statements, well or ill founded, which they contain with the mystical maunderings of patristic literature. The result is a series of discourses in which the enunciation of scientific facts alternates oddly with inflated periods and turgid rhetoric. The entire volume may be regarded as a striking example of misdirected ingenuity. It is a comparatively trivial fault in it that its author quotes mere compilers like Guillemin and Lockyer as of equal weight and authority with such men as Ball, Herschel, Newcomb, and Beckett. *Malgré* this, the student might derive a not inconsiderable amount of astronomical knowledge from our author's pages, into which facts have been emptied wholesale. With regard to the inferences from those facts, however, perhaps the less said the better. It may suffice to remind those disposed to attach any weight to the utterances of "the Fathers" that one of the very earliest of them, Clemens Romanus, derived an argument for the Resurrection from the veracious history of the Phœnix!

Wanderings in China. By C. F. Gordon Cumming. (Wm. Blackwood & Sons.)—We are not surprised to see this book in a second edition. No work of such abiding value and interest about the Celestials has appeared since Archdeacon Gray's "China," and to Miss Cumming must be awarded the palm for vivacity and picturesqueness of style. Faithful as a photograph, yet without its hardness, since the pages are aglow with the scenes described, is the picture which Miss Cumming presents of this strange land and people, in all the squalor and the splendour, the dignity and dirt, the fantastic and the frightful, which characterise life alike in the cities and the rice-swamps. Miss Cumming has brought together materials in plenty for the archæologist, the sociologist, and the folk-lorist; but perhaps the most striking features of these volumes are the insight into the domestic life of the "lily-footed" upper classes, to which Miss Cumming had the privilege of *entrée*, and the accounts of the State-recognised and universal ancestor-worship, with its resulting terrible burden of custom and expense which the laws of the land and the ingenuity of the priests impose, and with the arrest of material and moral

advance during centuries, for which it is primarily responsible. In all that Miss Cumming has to tell us on this matter, the strength of her observations has its contrast in the weakness of her inferences from them. Now and then we rub our eyes in the feeling that a missionary report has been accidentally stitched-in with the sheets, till we find that we are having the conventional comparisons between the Christian and non-Christian religions which the orthodox mind, with *primâ facie* warrant, but with obtuseness to underlying parallelisms and identities, invariably draws. And then we regret that, through lack of acquaintance with modern theories of the evolution of morals and religion, so genial and sympathetic a writer should be deficient in that sense of relation between the faiths of mankind which gives the key to problems otherwise puzzling and depressing. Mr. Herbert Spencer will find these volumes an armoury of weapons in defence of his theory of ancestor-worship as the base of myth and religion, but the coexistence of nature-worship with it must be set against that, and be allowed its weight in the argument that the base has a wider area than any one theory can cover.

Carlyle and the Open Secret of his Life. By Henry Larkin. (Kegan Paul, Trench, & Co.)—This book may be commended to intending students of Carlyle as a convenient and interpretative introduction, making clear many a dark saying of the man. It consists, in the main, of extracts from Carlyle's writings, and of expansions of the very useful and compact summaries which are appended to many of his works, and for which his readers have to thank Mr. Larkin. Then a few pages are given to Carlyle's relations with Lady Ashburton, and to sundry other causes of friction between the philosopher and Mrs. Carlyle, notably on questions of housekeeping cost, on all which the gossip-hunter may gorge himself in Mr. Froude's biography. But the open secret which is flaunted in the title is told in a couple of lines. It is this: Carlyle wanted to make history as well as write it; to become "one of the seven to eight hundred Parliamentary Talkers with their escort of Able Editors and Public Opinion." But the death of Peel appears to have wrecked any such purpose.

British Fungi. By Rev. John Stevenson, Hon. Sec. Cryptogamic Society of Scotland. (London: William Blackwood & Sons. 1886.) This is the first of two laborious and important volumes classifying the various species of those strange quasi-animal organisms of which the common mushroom is the type. The features, habitats, comparisons between different species in appearance and affinity, together with the spore-measurements, are catalogued in detail, and the author's established position in mycology, or that branch of botany which deals with fungi, combined with that of other authorities to whom his book is indebted, are guarantees as to its accuracy and completeness.

Buckle's Miscellaneous and Posthumous Works. Edited by Grant Allen. (Longmans.)—This is a new and abridged edition of the minor writings of Mr. Buckle which were issued in 1872 under the editorship of Miss Helen Taylor, whose biographical sketch, with its interesting contributions from Buckle's intimate friends, is reprinted. Mr. Grant Allen explains in his brief preface the principle of selection adopted, which wisely excludes the extracts from other authors by which the earlier edition was so unduly swollen. The longest and most important paper is on the reign of Elizabeth, and is largely concerned with the moral and economical state of England during that period. Both it and the numerous fragments, historical and miscellaneous, supply a goodly amount of rough material which students of history may work up with advantage. Buckle was a brave and high-souled pioneer in the investigation into causes determining human progress or stagnation, and if the results of a more complete and more scientifically conducted method have been to show the limitations of his data and their treatment, not the less is the debt of his age to so fearless and laborious a worker to be ungrudgingly recognised.

Ecclesiastical English. By G. Washington Moon. (Hatchards.)—This is Part II. of Mr. Moon's *exposé* of the grammatical and syntactical blunders of the Company of Revisers who have been tinkering with the Authorised Version of the Scriptures. The culprits' names, with their full academic dignities, are all arraigned, and then follows a mass of illustrative evidence in support of the indictment. They are, without doubt, what Wordsworth calls "bad, bold men," and the sentence upon them—Right Reverend Fathers in God and Professors all—is that they do forthwith repair to 16 New Burlington Street, to take private lessons in English on the terms advertised in the prospectus at the end of this book.

A Sea-Painter's Log. By R. C. Leslie. (Chapman & Hall.)—We are glad to renew acquaintance with certain vivid sketches of foreshore life and scenery which appeared in the *St. James's Gazette*, and which are now reprinted with the additional attraction of photographs, reproducing the author's sketches very delicately and softly. Mr. Leslie may take rank with a delightful company of writers—Grant Allen, Richard Jefferies, Phil Robinson, and others—who, leaving the cloud-capped snow-peaks, the majestic and imposing in Nature, skilfully and lovingly describe her quieter and less striking aspects—tidal rivers flowing through long stretches of lowland; mudlands, with their creeks and treacherous ooze, which to the unobserving eye seem tame and monotonous, but which, in the glory of colour they reflect, in the unbroken horizon that shuts out neither sunrise nor sunset, and in their solitude and silence, are rich in material for the artist, be he poet or painter. Mr. Leslie takes us over rough seas in quaint ships, manned by quaint salts of the past, but we like best to ramble with him along the seaboard, or by some decayed harbour with its broken-down quays, its picturesque craft, with here and there a skeleton of timber protruding from the "hard" like the bones of camels in the desert. The long-neglected, obscure towns on our southern and eastern coasts are coming more and more into fashion, and visitors to the old Cinque Ports, or to the rotten boroughs of the Suffolk coast, should take Mr. Leslie's book with them.

A Year in Brazil. By Hastings Charles Dent, C.E. (Kegan Paul, Trench & Co.)—Mr. Dent took advantage of a year's stay in Brazil, whither professional work called him, to collect information concerning the fauna, more especially entomological, of the country. The letters and notes written during his absence have been woven into a record which is unaffected, pleasant to read, and of value as well as interest. But the more important parts of the work, so far as the matters treated of are concerned, are relegated to appendices, the first of which tells us a good deal about the political and social condition of the empire, and the customs and ideas of the native races. Mr. Dent's remarks upon the finances of the country should be noted by the holders of Brazilian bonds, a security which, in our judgment, is too risky for *bonâ fide* investors. The second appendix deals with the natural history, climate, and geology of Brazil, and includes an excursus by the author into matters theological, the gist of which may be predicated from the prominence which he gives to his membership of the Victoria Institute on the title-page, and from the note appended at page 119 for the benefit of the Psychical Research Society. In Mr. Dent's judgment, acceptance of the theory of evolution leads to denial of a personal God who has revealed

Himself to the spiritual nature of man in His word, and to the intellectual nature of man in His works, and, since both revelations must accord, evolution is not true: species are not mutable, man has not risen from an ape-like ancestry, but, as Genesis declares, was created pure and noble, only, being left to himself, went to the bad, from which redemption finally rescues him. The subject is not to be discussed here, but it may be pointed out that the one important flaw in the reasoning is the assumption that a venerable and valuable collection of documents of unsettled origin, of uncertain authorship, and of disputed meaning, is in any sense a revelation. A revelation, which can only be from an omniscient source, must comply with two conditions, namely, make known matters which man cannot find out by himself, and make them known in language absolutely clear and guarded against all possible risk of alteration from transcribers, translators, and printers. The book, which has some pleasing photographs of Brazilian scenery, reproduced by the Meisenbach method, has a copious index—indeed, so copious as to embrace every triviality of the text.

Letters to Dead Authors. By Andrew Lang. (Longmans.)—Mr. Lang's power of cunning workmanship was never shown with happier effect than in these addresses to the members of the "choir invisible." Some of his critics have taken exception to the imitation of the style of the several authors addressed, but Mr. Lang may retort that "imitation is the sincerest form of flattery." Any way, this is not a book to be analysed or dissected; it is a delicate, graceful piece of writing, to be enjoyed in passivity of soul away from the din of reviewers and the strife of tongues. The letters to Thackeray and Shelley strike us as particularly fine.

Vanity Fair. Two Vols. (Smith, Elder & Co.)—It is a pity that Mr. Lang's letter to Thackeray could not have been prefaced to these initial volumes of a tasty pocket edition, for which the publishers are to be thanked, and which every lover of the great master—the greatest since Fielding—will welcome. How we alike renew our youth, and find echo of the deeper experience of life, as, wearied of the inane or nauseating fiction of the present, we reopen "Vanity Fair," "Esmond," and the rest, and rejoin the familiar company, known as if they had lived in the flesh amongst us.

Still a Wife's Sister. Three Vols. By A. E. Schlotel. (Griffith, Farran, & Co.)—After re-reading "Vanity Fair" who can be in the humour to enjoy a novel which, so far as its purpose may be divined, seems to teach how to dodge the Deceased Wife's Sister Bill? There is no lack of material for an interesting story in these volumes, but the author has let it run to waste over a thousand closely-printed pages, where it is lost in a veritable delta of prolixity, swamping syntax and sense with it. Re-cast and cut down to one-third of the present size, the story might run, and justify a description applied by the author to a novel by her heroine: "Much that would have been dull and heavy was made buoyant by wit and cheerful scenes."

Comrades. By Sarah Tytler. (Hodder & Stoughton.)—A graceful and wholesome story, with an outside tasty enough to make it a desired school prize.

The Determination of Rock-Forming Minerals. By Dr. Eugene Hussak. Translated by Erastus G. Smith, Ph.D. (New York: John Wiley & Sons; London: Trübner & Co.) The microscopic analysis of rock-sections, which Mr. Sorby was the first to make some thirty years ago, has proved a most important instrument in geological research, throwing light upon internal structures and origins. The present work describes the mechanical methods for preparing and examining rocks suitable for optical study, and also supplies tables of determination of minerals. It is essentially a practical handbook for the lithologist.

Autobiography of Friedrich Froebel. Translated and annotated by Emilie Michaelis and H. Keatley Moore, Mus. Bac. (Swan Sonnenschein & Co.)—The story of the founder and foundation of the Kindergarten system, for which may all childhood, present and to come, made happier by its teaching, and quickened into delight in gain of knowledge through employment of fingers as well as brains, bless Froebel's name. With the foregoing we may couple Miss Hale's *Infant School Management* (Stanford) as an excellent manual of practical application. The authoress has a worthy ideal of the teacher's duty, and of the prime importance of the "tone" to be given throughout the school, reminding one of the influence of Arnold of Rugby over his boys. Said one of them: "I can't tell the doctor a lie: he trusts one so." We like Miss Hale's insistance on the need of discrimination of mental and physical differences. Altogether she has written a good book, both for the home nursery and the school.

A Handy Guide to Norway. By Thomas B. Willson, M.A. (Stanford.)—We can testify, as old travellers in "Gamle Norge," that such a clear and concise guide to that land of stern grandeur and honest folk as the present book designs to be, is wanted. We can recommend it to intending tourists as giving them sufficient information for all practical purposes, and Mr. Stanford has done his usual share of good service in the small maps illustrating the several beaten tracks. For a first visit Route V. should be taken.

Official Catalogue to the Colonial and Indian Exhibition. (Wm. Clowes & Sons.)—*Her Majesty's Colonies: a Series of Original Papers issued under the authority of the Royal Commission.* (Same publishers.)—The Commission is to be thanked for this timely and valuable collection of papers on the origin and history of our several colonies, together with its stores of information about their peoples and productions. The introduction to the work is appropriately written by the author of the "Expansion of England." Prof. Seeley rarely warms to his subject, but he touches the right note when he defines the relation of the colonies to the mother-country as that of limbs whose life depends on a heart and brain outside themselves. For the union between us is not mechanical but vital, and they who would sever it are—well, dividers of men.

The Joyous Story of Toto. By Laura E. Richards. (Blackie & Son.)—The following report on this book is addressed to us by a competent critic, to whom we delegated our duty:—

"My Dear Father.—Toto is a very nice book. The plot is that Toto, who is a little boy, lives with his blind grandmother. He was very good to her, and very fond of the wild animals in the woods near his cottage. And since he liked them, they liked him too, and they came to him every day to tell him such pretty tales, so that it makes you think they must be real, and that the animals *did* talk. And it all ends very prettily. Edith."

English Coins and Tokens, with a chapter on Greek and Roman Coins. By Llewellynn Jewitt and Barclay V. Head. *Sea-Weeds, Shells, and Fossils.* By Peter Gray and B. B. Woodward. (Swan Sonnenschein, Le Bas, & Lowrey. 1886.)—In these additions to the "Young Collectors' Library" the respective writers have managed to give in small compass a succinct and clear introduction to each subject, as well as practical instructions in aid of the several tastes to which they appeal. Written by experts, and illustrated with woodcuts far above the average of manuals, the volumes are marvels of cheapness.

Historic Boys. By E. S. Brooks. (Blackie & Son. 1886.)—A wholesome book, manly in tone, its character sketches enlivened by brisk dialogue and high-class illustrations; altogether one that should incite boys to further acquaintance with the epochs in which Marcus Aurelius, Baldwin, Leo X., William the Conqueror, and other rulers of men whose careers are narrated, were central figures. We advise schoolmasters to put it on their list of prizes.

We have also received the following:—*Debrett's Peerage and House of Commons* (Dean & Son) for the current year. The Peerage has now reached the venerable age of 173 years, and improves like old wine; therefore needs "no bush" from us; while its fellow volume, packed with information, well set out, embodies changes up to February last.—*Templeton's Practical Mechanic's Workshop Companion* (Crosby Lockwood & Co.), reissued in enlarged form, with such needful revision as the advance of mechanical science demands. The new editor, Mr. Hutton, has done his work carefully and thoroughly.—*Notes on Holman Hunt's Pictures* (William Reeve), indispensable to the visitors to the collection now on view in Bond Street, and, moreover, contains a reprint of matter no longer easily accessible.—*Romance of Mathematics*, by P. Hampson, M.A. (Elliot Stock), a clever *jeu d'esprit* on the conquest of conics and cosines by Cupid.—*Sun, Moon, and Stars*, by Richard Russell (Ward, Lock, & Co.).—The fourth edition of Mr. Macleod's *Theory and Practice of Banking* (Longmans), of which vigorous and, in some respects, original work we hope to give fuller notice.—Part IV. of *The Rotifera or Wheel Animalcules*, by C. T. Hudson, LL.D., and P. H. Gosse, F.R.S. (Longmans).—*Who and What is God?* By Rev. J. Longland (Hamilton, Adams, & Co.).—*St. Luke's Gospel*, Preliminary Examination Scripture Manual, by Arthur Rich (Relfe Brothers).—The New York *Electrician*.—The *Woman Question*, by Edward and Eleanor Marx Aveling (Swan Sonnenschein & Co.).—*In the Watches of the Night*: Poems by Mrs. Horace Dobell (Remington & Co.)—The *Camera* (Wyman & Son), the first number of a monthly for "those who practice photography," which, both in letterpress and illustrations, makes a good start.

We have received a pile of elementary educational works from Messrs. Griffith, Farran, & Co., Messrs. Cassell & Co., and Messrs. Moffatt & Paige, but none of them call for any special notice here.

THE FACE OF THE SKY FOR AUGUST.

By F.R.A.S.

THE sun should be watched for the spots which appear from time to time on his disc. Map viii. of "The Stars in their Seasons" exhibits the aspect of the night sky. Minima of the variable star Algol ("The Stars in their Seasons," map xii.) will happen at 12h. 18m. P.M. on the 19th, and at 9h. 7m. P.M. on the 26th, in addition to other times, when their observation will be difficult or impossible. Mercury is an evening star for the first half of the month, and a morning star during the remainder of it. He is in inferior conjunction (or between the sun and the earth) on the 16th. He may be best observed after sunset very early in August, and before sunrise at the very end of it. Venus may be seen glittering over the east north-east part of the horizon before sunrise. Mars now merely looks like a big red star in the western sky, a little to the north of Spica Virginis ("The Stars in their Seasons," map v.). Otherwise the night sky is an entire blank as far as the planets are concerned, Jupiter, Saturn, Uranus, and Neptune all being invisible. The night of the 10th is that on which the familiar August shooting stars may be looked for. They radiate from the constellation Perseus, and leave trails of light in the sky. The moon enters her first quarter at 9h. 6·3m. P.M. on August 6, and is full at 6h. 42·2m. P.M. on the 11th. She enters her last quarter at 7h. 41·8m. P.M. on the 22nd, and is new 54·1m. after noon on the 29th. Six stars will be occulted by the moon at convenient hours for the amateur during the month. On August 5, 95 Virginis, a star of the 6th magnitude, will disappear at the moon's dark limb at 9h. 54m. P.M. at an angle from her vertex of 108°. It will not reappear at her bright limb until after it has set. On the 8th, 24 Scorpii, a 5th magnitude star, will disappear at the dark limb at 7h. 15m. P.M. at a vertical angle of 92°. It will reappear at the bright limb at 8h. 34m. at an angle of 255° from the vertex of the moon. On the 11th, *d* Sagittarii, another 5th magnitude star, will disappear at the dark limb of the moon at 6h. 44m. P.M. at an angle of 74° from her vertex. It will reappear at her bright limb at 8 o'clock at an angle from her vertex of 242°. On the 17th, 5 Ceti, a 6th magnitude star, will disappear at her bright limb at 10h. 3m. P.M. at an angle of 10° from her vertex, reappearing at 10h. 32m. at her dark limb at a vertical angle of 323°. On the same night B.A.C. 5, also of the 6th magnitude, will disappear at the bright limb at 10h. 11m. at a vertical angle of 62°, and will reappear at the dark limb at 11h. 21m. P.M. at an angle of 278° from the vertex of the moon. Lastly, on the 19th, ν Piscium, a $4\frac{1}{2}$ magnitude star, will disappear at the bright limb at 10h. 42m. P.M. at an angle of 68° from the moon's vertex. It will reappear at 11h. 47m. P.M. at her dark limb at an angle from her vertex of 261°. The rest of the occultations this month happen during the early morning hours. When our notes begin the moon is in Leo ("The Seasons Pictured," plate xxiv.), which at 5h. A.M. on the 3rd she quits for Virgo ("The Seasons Pictured," plate xxv.). She is travelling across Virgo until 4 A.M. on the 6th, at which hour she crosses into Libra ("The Seasons Pictured," plate xxvi.). Pursuing her course through the last-named constellation, she arrives at 4h. A.M. on the 8th on the boundary of the narrow northern strip of Scorpio. By 11h. 30m. on the same morning she has crossed this and entered Ophiuchus. Here she continues until 7 A.M. on the 10th, when she passes into Sagittarius, her passage through which occupies her until 8h. 30m. in the evening of the 12th. Then she enters Capricornus ("The Stars in their Seasons," plate xxi.). She leaves Capricornus, in turn, for Aquarius at 1 A.M. on the 15th, as she does Aquarius for Pisces at 2 A.M. on the 17th ("The Seasons Pictured," plate xxii.). Her journey through this great constellation is not completed until 9 A.M. on the 20th, when she arrives at the western boundary of the northern prolongation of Cetus, and through this she has passed by 11 o'clock the same night and entered Aries. She is in Aries until 3 A.M. on the 22nd, and then passes into Taurus ("The Seasons Pictured," plate xxiii.). Pursuing her path through the last-named constellation she arrives at 7 P.M. on the 24th on the boundary of the narrow northern strip of Orion. By 7 o'clock the next morning she has crossed this and emerged in Gemini ("The Seasons Pictured," map xxiv.). At 8h. 30m. P.M. on the 26th she leaves Gemini for Cancer. She is in Cancer until 7 A.M. on the 28th, when she crosses the boundary into Leo. Her passage across Leo occupies until 3 P.M. on the 30th, when she quits it for Virgo ("The Seasons Pictured," map xxv.). She is still in Virgo at midnight on the 31st.

Our Whist Column.

By "Five of Clubs."

ILLUSTRATIVE GAME.

THE following game illustrates the discard. *Y–Z* save an apparently lost game by following common-sense principles. Had they played according to the recent directive-discard system, *A–B* must have won.

THE HANDS.

B { S (*trumps*).—A, Q, Kn, 9. H.—A, K, Q, Kn. C.—A, 3. D.—K, 8, 3. }

B
A–B. 3

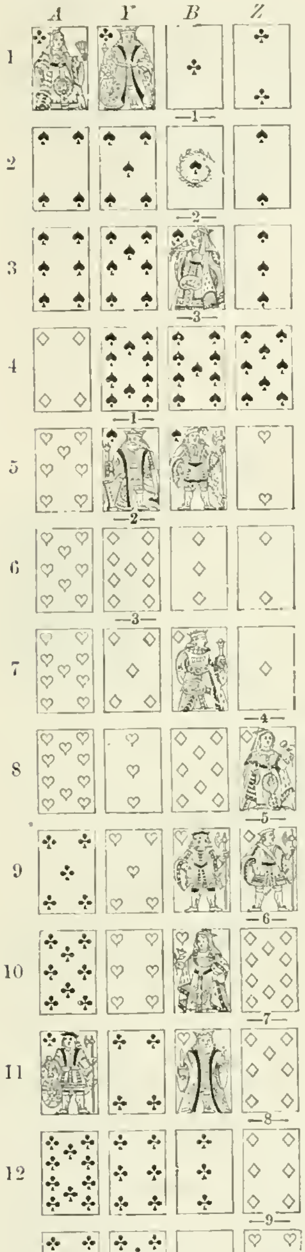
Y { S (*tps*).—K, 10, 7, 5. H.—6, 5, 3. C.—K, 7, 6, 4. D.—9, 5. }

Y | Z
Y–Z. 2 | *Tr*. S. 2

Z { S (*trumps*).—8, 3, 2. H.—4, 2. C.—2. D.—A, Q, Kn, 10, 7, 6, 2. }

A leads.

A { S (*trumps*).—6, 4. H.—10, 9, 8, 7. C.—Q, Kn, 10, 9, 8, 5. D.—4. }



THE PLAY.

Card underlined takes trick, and card below leads next.

1. *Y* should not have covered. With only three in suit, or with nine instead of seven as his second-best Club, he would have been right in playing the King. (See play second hand in "How to Play Whist.")

2. *B* holds two by honours in his own hand, and therefore "game" unless *Y-Z*, who are at the score of two, can make three by cards. Under these circumstances *B*'s play in leading out trumps is most unwise. If trumps are led at all, the most effective card would have been the nine, though in a plain suit Ace followed by Queen would of course be right.

3. *Y* wisely plays his smallest trump, being sure of two tricks if *B* goes on with the suit. Had he taken the trick, he would have left the major terrace with *B*; as it is, he retains it himself.

4 and 5. *Y* makes his terrace *A* properly discards from his shortest suit. *Y* is quite right in drawing *B*'s last trump. For there is no other chance of saving the game. *Y-Z* must make every other trick but one, and *Y* has not another trick in his hand. *Z* must not only have a long suit, but must not waste a single card from it. In any case, *Z* would play ill in following to the letter the wooden rule (suited only for wooden-headed players) of discarding from the suit he wants led because the trump lead came from the enemy. Anything more inconsistent with the principles of Whist strategy than this rule, as presented in this general form, it is almost impossible to conceive. "Play the card you can best spare, which will usually be one of your longest suit, when the enemy have command in trumps," is the only form in which the rule for discarding under such circumstances can be given; and here *A-B* have *not* command in trumps, while the *short* suit is that from which cards can best be spared. Had *Y* allowed the Heart discard to direct him to a Heart lead he would have played very ill. But luckily for himself and partner, he saw that the only chance they had was that *Z* might have length and strength in one suit, and sense enough not to discard from it, when probably every card of the suit would be wanted to save the game. Therefore

6. *Y* leads his best Diamond; *Z* finesses (only against one card be it noticed), and

7, 8, 9, &c. *Y* going on with Diamonds, *Z* makes six more tricks, saving and winning the game.

Had the score been "love all" and the game properly played on both sides, it would have resulted as follows:—

First trick taken by *A* (Club Queen); second trick taken by *Z* (ruffing *B*'s Ace), *Y* holding up King; third trick by *Z* (Diamond Ace); fourth trick by *A* (ruffing); fifth trick by *B* (trump Knave, to *A*'s defensive lead of trumps); sixth trick to *B* (trump Ace); seventh, eighth, and ninth tricks to *B* (Heart, King, Queen, Ace); tenth trick to *Y*, trump 10; and then two tricks fall to *A-B* however *Y* may play, one going to *Y*'s trump King. Result:—*A-B* make two by cards and count two by honours.

Again, had the score been "love all," and after five tricks played as in the actual game *Y* had regarded *Z*'s Heart discard as directive, *A-B* would have made five by cards!

Sun-Worship among the Blackfoot Indians.—The chief religious ceremony of the Blackfoot tribes is of foreign origin. This is the famous "Sun-dance," to which they, like the Dakota tribes and some of the Western Crees, are fanatically devoted. That this ceremony is not properly Algonkin is clearly shown by the fact that among the tribes of that stock, with the exception of the Blackfeet and a few of the Western Crees, it is unknown. Neither the Ojibways of the Lakes, nor any of the tribes east of the Mississippi, had in their worship a trace of this extraordinary rite. The late eminent missionary among the Dakotas, the Rev. Stephen R. Riggs (author of the "Dakota Grammar and Dictionary"), says of this ceremony: "The highest form of sacrifice is *self-immolation.* It exists in the Sun-dance, and is what is called 'vision-seeking.' Some, passing a knife under the muscles of the breast and arms, attach cords thereto, which are fastened at the other end to the top of a tall pole, raised for the purpose; and thus they hang suspended only by those cords, without food or drink, for two, three, or four days, gazing upon vacancy, their minds intently fixed upon the object in which they wish to be assisted by the deity, and waiting for a vision from above. Others, making incisions in the back, have attached, by hair ropes, one or more buffalo-heads, so that every time the body moves in the dance, a jerk is given to the buffalo-heads behind. The rite exists at present among the western bands of the Dakotas in the greatest barbarity. After making the cuttings in the arms, breast, or back, wooden setons—sticks about the size of a lead-pencil—are inserted, and the ropes are attached to them. Then, swinging on the ropes, they pull until the setons are pulled out with the flesh and tendons; or, if hung with buffalo-heads, the pulling is done in the dance, by successive jerks, keeping time with the music, while the head and body, in an attitude of supplication, face the sun, and the eye is unflinchingly fixed upon it."

Our Chess Column.

By "Mephisto."

ENGLISH PROBLEM COMPOSERS.

I.—C. Planck.

THIS composer of problems may, with profit to himself, adopt the motto, "By my work shall ye know me." Mr. Planck has not only done a great deal of work, but he has likewise done it well in every respect. His correctness in composition is excelled by none, while for originality of ideas and neat construction his problems have been famous all over the world. Mr. Planck has composed no less than thirty problems, which have either gained prizes, or have been honourably mentioned. This is, indeed, a fine record, and the best attainable record as far as modern problem composing goes. But we must confess to a feeling of regret, that the old classical ideas of problem composition have been entirely forsaken, at least as far as English composers are concerned. Not but what we admit that the modern canons of construction, purity of position, economy of forces, &c, are correct; but alas! these are considered primarily, and imagination has to take second place, whereas in classical problems imagination predominated without at all unduly straining the total effect of the problem.

By enjoying the following fine examples of Mr. Planck's art, it will be admitted that his compositions are, as a whole, far less open

to reproach in this respect, and are fully deserving of our praise and admiration.

No. 1.—Position.

White—K on KB8. Q on QR2. B's on Q4 and QR6. Kt on Q5. P's on K Kt2, 3, Q2, QR3. (Nine pieces.)

Black—K on K5. B on KB6. P's on K Kt1, 5, K3, Q3. (Six pieces.)

Mate in three moves.

No. 2.—Position.

White—K on QR3. Q on KR3. Kt's on QKt3, QR5. R on Q5. P's on KR5, Q6. (Seven pieces)

Black—K on K5. R on K Kt7. Kt on QB8. B on Q6. P's on KR4, QB3, QB7. (Seven pieces.)

Mate in three moves.

No. 3.—Position.

White—K on QKt sq. Q on Q sq. B's on KB8, QB6. Kt on QKt4. P's on K Kt3, 6, Q2, QKt5, QR2, QR1. (Eleven pieces.)

Black—K on Q5. Kt on QB1. P's on K Kt5, KB3, K3, Q1, 6. (Seven pieces)

Mate in three moves.

No. 4.—Position.

White—K on QR6. Q on KR7. Kt's on QB3, QKt4. B on QR2. P's on KB2, 6, K6, QB4, QR5. (Ten pieces.)

Black—K on Q5, P's on K2, KB6, QR6. (Four pieces.)

Mate in three moves.

No. 5.—Position.

White—K on KR8. Q on K sq. B's on Q3, Q8. R on QB5. Kt on K5. P on QKt3. (Seven pieces.)

Black—K on Q5. Q on KR7. B on K Kt8. Kt's on QR5, QR8. P's on KR3, K Kt7, KB5, QKt2, QR3. (Ten pieces.)

Mate in three moves.

No. 6.—Position.

White—K on K Kt sq. Q on QB3. B on Q6. Kt's on K3, QB sq. (Five pieces.)

Black—K on K5. B on KB8. Kt on QB sq. P's on KB3, 4, K Kt4, K3, 7, QB3, 5. (Ten pieces.)

Mate in three moves.

No. 7.—Position.

White—K on QKt8. B's on KB8, Q sq. Kt's on KB5, Q7. P's on KKt2, 5, QB2, QR5. (Nine pieces.)

Black—K on Q6. P on Q7. (Two pieces.)

Mate in four moves.

No. 8.—Position.

White—K on KB8. Q on KB7. B's on Q5, QR7. P's on K Kt4, QKt3. (Six pieces.)

Black—K on K4. B's on KB8, K8. Kt on QB7. P's on KR3, K Kt2, QB6. (Seven pieces.)

Mate in three moves.

No. 9.—Position.

White—K on QKt3. Kt's on KB6, Q4. B's on QB3, QB6. P's on KR2, QB2, QR6. (Eight pieces.)

Black—K on QB4. P on QR2. (Two pieces.)

Mate in four moves.

No. 10.—Position.

White—K on K Kt8. Q on KB3. R on KB sq. B's on K sq, QB4. Kt on K1. P on QR3. (Seven pieces.)

Black—K on Q5. B on K Kt6. Kt on KR sq. P's on KR3, 5, KKt3, KB7, Q3, 4, QR5. (Ten pieces.)

Mate in three moves.

No. 11.—Position.

White—K on K sq. Q on QKt sq. Kt's on KB4, Q5. R on QB6. P's on KR4, K Kt3. (Seven pieces.)

Black—K on K4. P's on KR2, 4, K3, Q3. (Five pieces)

Mate in three moves.

No. 12.—Position.

White—K on K8. Q on KKt sq. B's on K Kt8, Q8. Kt's on Q5, QB5. P's on KR2, KB2, 4, QR3. R on Q sq. (Eleven pieces.)

Black—K on Q5. Kt on Q6. B on QR7. P's on KR6, K Kt3, Q3, QB3, QB6. (Eight pieces.)

Mate in three moves.

SOLUTIONS.

No. 1.—1. $\frac{\text{Kt to Kt1}}{\text{K} \times \text{B}}$ 2. $\frac{\text{Q to R sq. (ch)}}{\quad}$, &c. If 1. $\frac{\quad}{\text{K to B4}}$ 2. $\frac{\text{Q} \times \text{P (ch)}}{\quad}$, &c., and other variations.

No. 2.—1. $\frac{\text{Kt to B4}}{\text{K} \times \text{R}}$ 2. $\frac{\text{Q to B3 (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{P} \times \text{R}}$ 2. $\frac{\text{Q} \times \text{P (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{B} \times \text{Kt}}$ 2. $\frac{\text{Q to B5 (ch)}}{\quad}$, &c., and other variations.

No. 3.—1. $\frac{\text{B} \times \text{P}}{\text{K to K4}}$ 2. $\frac{\text{Q to R sq.}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{Kt to K5}}$ 2. $\frac{\text{Kt to B6 (ch)}}{\quad}$ &c., and several other variations.

No. 4.—1. $\frac{\text{P to B5}}{\text{K} \times \text{P}}$ 2. $\frac{\text{Kt to R4 (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{K to K4}}$ 2. $\frac{\text{Kt to Q3 (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{P} \times \text{P}}$ 2. $\frac{\text{Kt to Kt5 (ch)}}{\quad}$, &c., and others.

No. 5.—1. $\frac{\text{B to QKt5}}{\text{K} \times \text{R}}$ 2. $\frac{\text{Kt to Q3 (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{P} \times \text{B}}$ 2. $\frac{\text{Q to Q2 (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{Q to R4}}$ 2. $\frac{\text{Q} \times \text{B (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{P to B6}}$ 2. $\frac{\text{Q to Kt4 (ch)}}{\text{\&c.}}$ and others (White threatens 2. Kt to B6 (ch)).

No. 6.—1. $\frac{\text{Kt to Kt4}}{\text{K to Q4}}$ 2. $\frac{\text{B to K5}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{P to B5}}$ 2. $\frac{\text{Kt to B2 (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{P} \times \text{Kt}}$ 2. $\frac{\text{Q} \times \text{P (ch)}}{\quad}$ and other variations.

No. 7.—1. $\frac{\text{P to Kt6}}{\text{K to K5}}$ 2. $\frac{\text{B to B2 (ch)}}{\text{K to Q4}}$ 3. $\frac{\text{Kt to K3 (ch)}}{\text{\&c.}}$ If 2. $\frac{\quad}{\text{K to B5}}$ 3. $\frac{\text{B to R6 (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{K to B5}}$ 2. $\frac{\text{Kt to Kt6 (ch)}}{\text{K to Q6}}$ 3. $\frac{\text{B to Q6}}{\text{\&c.}}$

No. 8.—1. $\frac{\text{B to R8}}{\text{B to Q5}}$ 2. $\frac{\text{B to Kt8 (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{Kt to K6}}$ 2. $\frac{\text{Q} \times \text{P (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{P to Kt3}}$ 2. $\frac{\text{Q to QB7 (ch)}}{\quad}$, &c.

No. 9.—1. $\frac{\text{B to B3}}{\text{K to Q3}}$ 2. $\frac{\text{B to QKt1 (ch)}}{\text{K to K4}}$ 3. $\frac{\text{Kt to Q7 (ch)}}{\text{\&c.}}$ If 2 $\frac{\quad}{\text{K to B2}}$ 3. $\frac{\text{B to Kt7}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{K to Kt3}}$ 2. $\frac{\text{Kt to K6}}{\text{K moves}}$ 3. $\frac{\text{Kt to Q7}}{\text{\&c.}}$

No. 10.—1. $\frac{\text{B to Kt4}}{\text{P} \times \text{B}}$ 2. $\frac{\text{Kt to B5, \&c.}}{\quad}$ If 1. $\frac{\quad}{\text{K} \times \text{B}}$ 2. $\frac{\text{Q to K2 (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{K to K4}}$ 2. $\frac{\text{B} \times \text{P (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{Kt moves, \&c.}}$ 2. $\frac{\text{B to Q3}}{\text{\&c.}}$

No. 11.—1. $\frac{\text{R to B7}}{\text{P to R3}}$ 2. $\frac{\text{Kt} \times \text{KP, \&c.}}{\quad}$ If 1. $\frac{\quad}{\text{P} \times \text{Kt}}$ 2. $\frac{\text{R to K7 (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{K to Q5}}$ 2. $\frac{\text{R to B4 (ch)}}{\text{\&c.}}$

No. 12.—1. $\frac{\text{Q} \times \text{P}}{\text{K} \times \text{Kt}}$ 2 $\frac{\text{Q} \times \text{P (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{BP} \times \text{Kt}}$ 2. $\frac{\text{Q to K4 (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{QP} \times \text{Kt}}$ 2. $\frac{\text{B to B6 (ch)}}{\text{\&c.}}$ If 1. $\frac{\quad}{\text{B to B5}}$ 2. $\frac{\text{Kt to K6 (ch)}}{\text{\&c.}}$ and other variations.

Contents of No. 9.

TERMS OF SUBSCRIPTION.

"Knowledge" as a Monthly Magazine cannot be registered as a Newspaper for transmission abroad. The Terms of Subscription per annum are therefore altered as follows to the Countries named:

	s.	d.
To West Indies and South America	9	0
To the East Indies, China, &c.	10	6
To South Africa	12	0
To Australia, New Zealand, &c.	14	0

To any address in the United Kingdom, the Continent, Canada, United States, and Egypt, the Subscription is 7s. 6d., as heretofore.

KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART

LONDON: SEPTEMBER 1, 1886.

THE UNKNOWABLE.

By Richard A. Proctor.

WORSHIP OF THE SUN-GOD.

BEFORE turning from the consideration of the virgin-born Sun-god, naturally recognised, among nations worshipping the sun, as new-born with each new day, with each new year, and with the beginning also of longer periods forming Great Years, I may call attention, in passing, to the possibility that we may find in this belief the explanation of a curious passage in classical literature, which has long been regarded as enigmatical.

In Virgil's "Pollio" we find the lines:

> Jam redit et Virgo, redeunt Saturnia regna;
> Jam nova progenies cælo dimittitur alto. . . .
> Te duce, si qua maneut sceleris vestigia nostri,
> Irrita perpetuâ solvent formidine terras . . .
> Pacatumque reget patriis virtutibus orbem;

which may be rendered: "Now returns the Virgin, Saturnian realms return; from heaven above an offspring new descends. With thee to guide, if any traces of man's wickedness remain, failing they shall free all countries from perpetual dread . . . He shall govern the world in peace, with the virtues of his father."

It will be observed by those who have considered our account of the expectations associated with the birth of each new sun-god—akin, but on an enlarged scale, to the hopes men form with the birth of each new year, nay, of each new day—that the above passage presents the same hopes, the same aspirations. We are thus led to regard the reference to the Virgin as no accidental coincidence. All Virgil's astronomical references belong to a time long preceding his own. For instance, he speaks of the time of year—

> Candidus auratis aperit cum cornibus annum
> Taurus . . .

—"when the white Bull opens the year with his gilded horns"; whereas for two thousand years before his time spring had opened with the sun in Aries, not in Taurus. We know not from what source Virgil derived his astronomy; it is evident only that, like the astronomy of Aratus (borrowed from Eudoxus), the astronomy of Virgil was not his own.

But it chances that we do know something of the source from which Virgil's "Pollio" was in large part derived. That Eclogue was taken from a Sibylline prophecy, though, doubtless, Virgil used all a poet's license in the use of the sacred leaves from which he borrowed his inspiration.

Now, the very antiquity of the Sibylline Prophecies—an antiquity so great that the origin, and even the authenticity, of most of them is altogether lost—would assure us, apart from other evidence, that they related to the early, wide-spread, and reasonable worship of the sun, a cult which was in truth, while it lasted, the worship of the unknown and seemingly unknowable Power of which the sun seemed to be the visible manifestation. We might safely infer that the Sibyls had an office akin to that which we recognise in Deborah and in Huldah the prophetess—viz., to determine, as by a sort of divine inspiration (like that of the Delphic priestesses), the proper forms for the worship of the Unknowable. But we are not left to deduce this inferentially. We have historic evidence that the Sibyls were priestesses of the Sun-god. Thus Pausanias preserves the inscription on the monument erected to the Samian Sibyl in a grove sacred to Apollo Smintheus (Apollo being the Sun-god, in his character as dispeller of the darkness of night and of winter). A hymn to the same god, well known to the inhabitants of Delos in the time of Pausanias, was attributed to the still more ancient Erythræan Sibyl, who was supposed to have predicted the issue of the Trojan war. There were many sibyls, however, all belonging to races which were either sun-worshippers of their own notion, or had borrowed sun-worship from races of earlier civilisation—as the Egyptians, Babylonians, and Persians on the one hand, and the Hebrews, Greeks, and Romans on the other.

We may recognise, then, in Virgil's lines a very curious relic of ancient sun-worship. The original sibylline verses from which he borrowed formed doubtless a song welcoming the birth of the sun-god, and expressing the customary aspirations regarding the time heralded by his arrival.*

Pursuing further the features in which the ancient myths of sun-gods and their birth resembled each other—as they naturally would in all circumstances having an astronomical or otherwise physical interpretation—we find in nearly every case the following circumstances:—

First, the birth of the sun-god ruling the new year was announced by the appearance of a star in the east.

Secondly, the sun-god was born in a cave, and attended on by herdsmen—cowherds, shepherds, goatherds, according to the habits of the race to which the myth belonged.

Thirdly, gifts of precious stones or gold, of perfumes, and of substances suitable for sacrificial fires, were offered in honour of the new-born sun-god.

Strange as such circumstances as these may appear to the philosophical mind, they seemed natural enough in the days to which they properly belonged. The astronomer of to-day may be disposed to smile at the thought that a Being worshipped as God of the Universe should be regarded as honoured by the appearance of one star among the millions of millions of suns within his domain. And it may appear still less respectful to absolute Deity to picture It as receiving with satisfaction the adoration of cowherds, goatherds, or shepherds, and gifts of objects as useless to Infinity as they would be unsuited to a babe. But the worshippers of the Buddha, Crishna, Mithras, Apollo, Serapis, and the rest, must not be blamed for retaining ideas belonging to a religion so ancient that its origin could not be traced by

* Pope calls attention to the "remarkable parity between many of the thoughts in the 'Pollio' of Virgil and those in" the passages of Isaiah imagined to have been prophecies of the coming of a Messiah: "Behold, a Virgin shall conceive and bear a son"—"Jam redit Virgo jam nova demittitur cœlo alto progenies." "Of the increase of his government and of his peace there shall be no end"—"Illo duce, sceleris vestigia nostri irrita perpetuâ solvent formidine terras." "Upon the throne of David [his father] and upon his kingdom to stablish it with justice for ever and ever"—"Pacatumque reget patriis virtutibus orbem." Accordingly Pope is tempted to follow Virgil in making an eclogue out of the mystic sayings of supposed prophecy, calling the poem "'Messiah, an Eclogue,' in Imitation of Virgil's 'Pollio.'" Herein perhaps Pope "builded better than he knew," becoming one of a very long line of adapters of sun-worshipping ideas to specific race-religions.

them, and so widespread that they might well be excused for regarding it as universal. The idea that honour had thus been rendered to Deity had arisen when as yet the idea of Deity was imperfect; and there was certainly no intentional insult to Deity in the continued association of these time-worn yet venerable ideas with the idea of the Infinite, the Unknown, the Unknowable Power, which lies beyond the sun in his might, beyond all the glories, seen and unseen, of the infinite universe, and behind its most awful mysteries.

Whatever opinion we may form as to the reasonableness, or (with our knowledge) as to the propriety, of the ideas here considered, there can be no question as to the actual fact that in all sun-worshipping religions, and in all religions derived from them or retaining their ceremonial, these ideas prevailed. It is obvious, indeed, that men in those days would feel that they were wanting in respect if they did not associate with their sun-god the same idea of the obeisance of nature which they regarded as appropriate to ordinary kings and heroes. As Dr. Geikie correctly remarks in his "Life of Christ"—though he strangely fails to note the significance of the fact—"It was universally believed that extraordinary events, especially the birth and death of great men, were heralded by appearances of stars, and still more of comets, or by conjunctions of the heavenly bodies." A preposterous belief truly; but not so at the time when it was thus universally accepted. *We* perceive the folly of it; *they* regarded it as too natural to be questioned: some, of whom Drs. Farrar and Geikie may be regarded as types, can at one and the same time perceive the folly of the belief, and accept the universality of this false belief as evidence for a recorded event.

Even the Egyptians and Babylonians, far as they were from perceiving the inherent absurdity of sun-worship, were too well acquainted with astronomical laws to fall into the mistake of imagining casual stars as heralds of great events. They knew that known stars heralded definite astronomical events. The heliacal rising of some known star in any given era—lasting several hundred years—marked for them the beginning of the annual career of their sun-god. The appearance of this star in the east before sunrise would be the manifestation of the birth of the sun of the year. Accustomed, as we find they were, to recognise a slow and gradual change in the season of the heliacal risings of the stars, they might well recognise the beginning of some new and fortunate era when first some conspicuous star rose heliacally at the birth of the new year. But in any case the annual heliacal rising of the star which showed that the new year had begun would be welcomed with rejoicings. Those who "blew up the trumpet in the new moon" would welcome still more solemnly the new sun. The ruler of the year was naturally held in higher honour than the ruler of the month. When the priests, who were also the astronomers or magi, announced that they had seen the star of the sun-god in the east (that is, rising heliacally), all sorts and conditions of men would be expected to offer praises to the new-born monarch of the year. Sacrifices and burnt offerings, with perfumes and sweet savours, would be offered by the priests. No other annual observance would appear so sacred except that belonging to the time when the sun, thus born weak and lowly, in the depressed part of the zodiac which might be compared to a cave,* should pass to the glorious part of his career.

Let us, however, see how far the ancient stories of sun-gods agree in presenting the three features mentioned above.

(To be continued.)

MR. FROUDE ON GREATER BRITAIN.*

IF Mr. Froude's special purpose in writing "Oceana" we wish to say little here. In truth, the problem with which he undertakes to deal is one of considerable complexity. We doubt whether he or any man can really form an opinion as to the future development of Oceana, or the best way in which that development may be directed. Our view of his opinions about this difficult problem may be best expressed perhaps in words of his own—whose application, however, to social science we consider unsound. "It is in the marvellous power in men to go wrong," he says, "that the impossibility stands of forming scientific calculations of what men will do before the fact, or scientific explanations of what they have done after the fact." . . . In history "the phenomena never repeat themselves. There we are wholly dependent on the record of things said to have happened once, but which never happen or can happen a second time. There no experiment is possible; we can watch for no recurring fact to test the worth of our conjectures." If Mr. Froude, whose favourite literature is the literature of ancient Greece, believes that the study of history cannot enable us to conjecture the probable future of States under conditions seemingly resembling those which existed in former times, it

* In the case of Herakles, this same part of the zodiac was represented as a stable to be cleansed by the might of that solar hero from the gloom and darkness which seem to defile it. This zodiacal task was not associated with the birth of Herakles. His first achievement was strangling the serpents which represent the clouds of night. Throughout the ancient solar myths we recognise the intermixing of ideas relating to the sun as god of the day and to the sun as god of the year—Herakles and Iole at morn and eve (the time of the birth and death of the day sun), and Herakles strangling the serpents, these stories relate to the day, while Herakles going through his twelve zodiacal labours and Herakles conquering the Lernæan Hydra (the clouds of winter) are stories belonging to the year. The same difficulty is found, and the same explanation presents itself, in the story of Samson (Shemshin, from the older Shamash, the sun), which is unmistakably a solar myth; but most of the story of the Semitic solar hero relates to the sun as ruler of the year. Dalilah, "the languishing one," represents winter. The hero's hair, as in all sun stories, represents the sun's rays. The Philistines are the clouds, which darken (or blind) the sun when his rays have been cut off in winter. The destruction of the Philistines at the time of their celebration in honour of the fish god, Dagon (the winter deity supposed to have triumphed over the sun as god of summer), represents the triumph of the sun when, at spring, he returns to the glorious part of his course, over the clouds of winter, by which, till then, he had been, as it were, imprisoned. Yet many of the triumphs of Samson over the Philistines obviously represent the triumph of the sun of day over the gloom of night. The Gaza story combines both ideas. It represents the triumph of the midsummer sun, manifesting its power when, as yet, the middle of the night is scarcely past. All the absurdities of the story of Samson, considered as relating to a ruler or judge in Israel, disappear, and the interest it derives from its venerable antiquity is developed, when it is thus read as a very ancient adaptation—scarcely altered in the adapting—of a far more ancient myth.

In the same way the story of Jonah loses its absurdity when we recognise Jonah as identical with the Oannes of the Chaldeans, the winter god or hero, issuing from the great fish which represented the gloom and cold of winter. So reading the strange old story, we need no longer be concerned to inquire what sort of a fish that may have been which could swallow a man whole, and in whose interior a man might remain alive three days and three nights. Indeed, many occasions for somewhat degrading attempts to reconcile the impossible and absurd with known facts might be avoided if men would be content to take the stories and myths of ancient days for what they obviously are, instead of insisting on believing in them as records of historical events.

* "Oceana; or, England and her Colonies." By James Anthony Froude. London: Longmans & Co.

seems unlikely that he should hope to arrive at assured convictions respecting the future fortunes of communities like the English-speaking colonies under conditions utterly unlike any of which history has yet left us the record. We reject Mr. Froude's doctrine that a science of history is impossible, but we may believe with him that at present no such science exists; and we may feel absolutely assured that this opinion is sound so far as it is based on internal evidence. Therefore we cannot attach any great importance to Mr. Froude's views on the future of England and her colonies. The subject would tax the fullest powers of a science which by his own account will never exist. Even if he is in this mistaken, and the science already exists, it certainly is but in its infancy; and Mr. Froude's own assurance should satisfy us that he himself has no inkling of its teachings.

We propose to consider "Oceana" as a contribution to that department of literature which Mr. Froude says is provided "for those who want to be entertained without feeling that they are losing their time." As a book of travels "Oceana" is chiefly remarkable for the wideness of its range and the confident interpretation of the bird's-eye view which such a survey can alone afford. Mr. Froude pronounces an opinion on the climate of the middle and eastern States of America, after passing from the Rocky Mountains to Chicago in the last week of April. "It must be with the eastern and middle States as they say of Castile, *nueve meses del Invierno y tres del Infierno* (nine months of winter and three of hell). Winter is long and harsh; summer is brief and burning." Now, as a matter of fact, climate varies as widely in the eastern and middle States of America as it does in the eastern and middle countries of Europe, and in any section of any one of the eastern or middle States the weather differs as much from year to year as it does with us at home. But in those parts of the States where the contrast between the cold of winter and the heat of summer is most trying the average weather is by no means such that the inhabitants consider our English weather can possibly be better or even nearly as good. They know, indeed, as a rule, as much about our English weather as Mr. Froude knows about weather in America, having formed their ideas on just such evidence as he has had (and is now giving to the English public) in regard to American weather. But, in the main, they hold their weather to be much better than ours. The winter does not last nine months; often it does not begin before December, sometimes not till January, and it is often over by the middle of March. Summer, again, has usually two months of delightful weather, much like the best summer weather of England. Spring, indeed, is apt to last but a short time; but, on the other hand, autumn lasts much longer than with us; and the autumn weather of the middle and eastern States is usually charming, fully equal to our loveliest spring weather. The bitterness of the winter cold for occasional short spells is indeed trying, especially to those not accustomed to it. And there are sometimes summer days which might almost deserve to be called days *del Infierno*. But there are as many days of "London particular" in our metropolis; and, in its own way, a London fog is quite as suggestive of the infernal regions as a sweltering summer's day in Missouri. (For it should be remembered that, according to the opinion of the best authorities, the place of torment, though a scene of quenchless fire, is also, somehow, a place also of utter darkness: the heat of hell, in fact, would seem, from the account of those acquainted with its qualities, to belong to the ultra-red portion of the spectrum.)

Naturally, then, we reject Mr. Froude's very crude interpretation of American working energy. Americans "work as they do," he says, "because work alone can make life tolerable on such a soil, and in such a climate." Work is doubtless the true answer to the unmanly whine, "Is life worth living?"—but certainly there is nothing either in the soil or climate of the United States which should make life less enjoyable, when duly sweetened by manly toil, than it is in the old country.

Akin to Mr. Froude's absurdly hasty judgment on these wide general questions is his decision on matters of detail. On his way from Denver to Chicago he crossed the Missouri and the Mississippi, probably at Omaha and Rock Island, respectively—though, for anything "Oceana" says, it may have been at Kansas City and Quincy that he crossed the "big rivers." Yet he considers himself justified from this comparatively slight acquaintance with these grand rivers, and a few minutes' experience even of their aspect at one place along each, to tell his readers all about them. He has already pronounced a verdict against American scenery, having seen only a narrow strip selected for its flatness; he has decided that the forest trees are small and insignificant, having seen them only in places where the largest had long since been cut down; and then he goes on to deal with the great rivers. "The rivers!" he says. "Yes, the Missouri and the Mississippi are grand rivers, if bigness makes grandeur. The mighty volume of their water rolls on, carrying with it the rainfall of an enormous continent; but their turbid and yellow streams, fringed with unwholesome pine swamps, suggest only to the imagination that they are gigantic drains." It was an English physicist who spoke of the Thames as a great sewer, and *he* was hardly thought to have done full justice to the river whose graceful stretches past Richmond and Twickenham, and by Henley, Maidenhead, and Kingston, our poets have sung and our oarsmen love; yet Faraday at least knew thoroughly how far the Thames fulfils the office he assigned to it. Every river, inasmuch as its drains a country or a continent, is a more or less gigantic drain; and most rivers which flow through great cities are partly also sewers; but passing once across the Missouri and once across the Mississippi no more justifies a traveller in speaking of these great rivers as exceptionally drain-like in character, than reading a page of Mr. Froude's "Oceana" would justify us in saying that the book contains nothing but hasty judgments and unsatisfactory opinions.

There is, indeed, much in "Oceana" to interest those "who want to be entertained without feeling that they are losing their time." The account of the inland travelling in the northern island of New Zealand is interesting and in parts amusing, though scientific knowledge is not greatly increased by anything said or suggested respecting the marvellous white and pink terraces. The description of Mr. Froude's visits to Victoria and New South Wales is wanting in fulness, but some of the details are worth reading. The following extract from this portion of "Oceana" may be taken as a fair sample of Mr. Froude's manner; it relates also to an important Australian success:—

"While we were resting at Mount Macedon, Mr. Gillies had arranged another expedition for us to see a vineyard at a place called St. Hubert's, where the only entirely successful attempt to grow fine Australian wine had been carried out, after many difficulties, by Mr. Castella, a Swiss Catholic gentleman from Neufchatel. The visit was to be partly on our account that we might see what Victorian energy could do besides raising gold. It was also official, for Sir Henry Loch was to go with us as a recognition of Mr. Castella's merits to the colony. Australian wines had failed hitherto, as they had failed at the Cape, either from excess of sugar in the grapes, or from an earthy flavour contracted from the soil. The hock which we had tasted at Adelaide had been palatable but commonplace. Only experiments protracted through generations can determine in what situations wine

deserving the name can be produced. The flavour of a grape tells you nothing of the final flavour of the fermented juices. The same vines grown in two adjoining fields where the stratification or the aspect is different yield completely different results. The wine, too, must be kept for several years before the flavour into which it will ripen is defined. The best, therefore, which can be obtained in a new country is tentative and imperfect. Mr. Castella, however, had received honourable recognition from the best European authorities at the Sydney Exhibition for his hocks and clarets. The Governor was to go over his manufactory and congratulate him on his triumph. St. Hubert's was fifty miles from Melbourne in the valley of the Yarra. The blue satin railway carriage took us to the nearest station. There we clambered upon an old fashioned four-horse coach, and after a dusty drive of eight miles we reached a large roomy, straggling house, built with attempts at ornamental architecture, high-gabled roofs, a central tower with a flying outside staircase and gallery, the inevitable deep verandahs, and, as Mr. Castella's guests were often numerous, detached rooms, run up with planks, scattered in the shrubberies. The Yarra wound invisibly between deep banks across the plains in front of the windows. Behind it, far off, was a high range of mountains, from which columns of smoke were rising in half a dozen directions from forest bush fires, either lighted on purpose to clear the ground, or the careless work of wood-cutters or wandering natives. The fields immediately adjoining were the most brilliant green. The vines were all in full leaf. There were three hundred acres of them standing in rows, and staked like raspberry bushes, each bush powdered with sulphur, and smelling strongly of it. Our host himself was a vigorous, hale-looking man of sixty or upwards, with lively French features, light grey, merry eyes, with a touch of melancholy at the bottom of them—to be recognised at once as an original person well worth attention. . . . We were walked over the estate under our umbrellas, for the sun was blazing down upon us. We saw the vines growing, the presses, the rows of hogsheads in the cellars, the vats in which the grapes were trodden. I learnt here, as a fact new to me, that if fine wine is wanted, the human foot is still in requisition. Machinery crushes the grape-stone, and taints the flavour." [One would say that a suitable material could be produced which should give the same quality of pressure as the human foot supplies.] "We had to taste from various casks, and profess to appreciate the differences, which we none of us could," [We venture to question whether Mr. Castella really required his visitors thus to "say the thing which was not."] "for the palates of the uninitiated soon lose the power to discriminate."

We quote no more, but the whole account of this visit is very interesting—especially so to us, perhaps, because we had already heard so much from a kinsman of Mr. Castella's respecting that gentleman's success at St. Hubert's. Our author's sketch of Mr. Castella's partner, Mr. Rowan, a relative of Hamilton Rowan, with his anecdotes of Smith O'Brien's rebellion, including a battle in Ulster in which five hundred Catholics were killed, but of which history has hitherto declined to leave any records, is amusing. We hope it is a little more trustworthy than the account of a certain American host, who came out upon Mr. Froude with a saying about Niagara which Mr. Froude regards as new, but which has been repeated, to our personal knowledge, for at least a quarter of a century as an ancient jest, the remark, namely, that the falling of water over a precipice is nothing wonderful, "the wonder would be if the water did *not* fall." Mr. Froude seems, indeed, to have been unfortunate in being made the victim of several stories such as Americans keep for *gobemouches.* He may have seen "a mansion travelling without the help of an Aladdin's lamp"; but it assuredly does not quite so commonly happen as his account would imply that, "if a house is placed inconveniently, they lift it on rollers, and move it bodily from one place to another, while the occupants sleep and eat and go on with their employments as if nothing were happening."

Mr. Froude's touches at science are amusingly weak. He mixes with remarks on observations made at Melbourne by that faithful worker, Mr. Ellery, remarks on the contradictions of science, seeing that "he had read in a French scientific journal how the earth's axis had once been at right angles to the ecliptic, whence it had slowly inclined, as we see a spinning-top incline, till it had reached an angle of 45° or more, and was now half-way back to the perpendicular." We shall hear next that Mr. Hampden's absurdities, because they may have been mentioned in a scientific journal, indicate the helplessly unsatisfactory state of astronomy. "How many times," maunders Mr. Froude (really we can use no more respectful expression), "must we outsiders learn up our science, and then unlearn it? Each new generation of philosophers laughs at the conclusions of its predecessors." Considering the respect with which the most advanced astronomer of to-day traces the progress of astronomy from the time of Galileo to our own, nay the esteem in which the labours of Hipparchus and Ptolemy are held (even their misapprehensions being by no means ridiculed), these sayings of our author's would be altogether unjustified, even though suggested by real discoveries. As relating to a preposterous paradox such as only a man altogether ignorant of dynamical laws could have imagined they appear particularly preposterous.

Mr. Froude suggests that the heavy eastward winds of high latitudes may counteract the retarding influence of the westward flow of the tidal wave on the earth's rotation. Such a suggestion might do very well for the author of the paradox about the earth's axial pose, for it implies the same sort of ignorance of mechanical laws. Eastward winds can only exist as counterbalancing westward ones, and action and reaction being always equal, there can be no slightest trace of eastward beyond westward tendency in atmospheric movements.

"Oceana," however, despite these defects, is a book well worth reading by those who would form an idea of the widespread influence and of the rapid growth of the English-speaking communities. Not perhaps quite consciously, Mr. Froude does much in this volume to show how shallow and semisavage is the imperial idea of England's place in the world's history, how noble and worthy on the contrary her position as the mother of great nations of the future.

ETNA'S ERUPTIONS.

(*Continued from p.* 301.)

THE eruption of 1819 was in some respects even more remarkable than that of 1811. The Val del Bove, which, as already mentioned, breaks in upon the dome of Etna upon the eastern side, was covered by a sea of burning lava. Three large caverns had opened not far from the fissures, out of which the lava had flowed in 1811; and from these, flames, smoke, red-hot cinders, and sand were flung out with singular impetuosity. Presently another cavern opened lower down, but still no lava flowed from the mountain. At length a fifth opening formed, yet lower, and from this a torrent of lava poured out, which spread over the whole

width of the Val del Bove, and flowed no less than four miles in the first two days. This torrent of lava was soon after enlarged by the accession of enormous streams of burning matter flowing from the three caverns which had formed in the first instance. The river of lava at length reached the head of the Colonna Valley, where there is a vast and almost vertical precipice, over which the lava streamed in a cataract of fire. But there was a peculiarity about the falling lava which gave to the scene a strange and awful character. As the burning cascade rushed down, it became hardened through the cooling effects due to its contact with the rocky face of the precipice. Thus, the matter which had flowed over the head of the valley like a river of fire fell at the foot of the precipice in the form of solid masses of rock. The crash with which the falling crags struck the bottom of the valley is described as inconceivably awful. At first, indeed, the Catanians feared that a new eruption had burst out in that part of the mountain, since the air was filled with clouds of dust, produced by the abrasion of the face of the precipice as the hardened masses swept over it.

The length of time during which the lava of 1819 continued to flow down the slopes of the great valleys is well worth noticing. Mr. Scrope saw the current advancing at the rate of a yard per hour nine months after the occurrence of the eruption. The mode of its advance was remarkable. As the mass slowly pushed its way onward, the lower portions were arrested by the resistance of the ground, and thus the upper part would first protrude itself, and then, being unsupported, would fall over. The fallen mass would then in its turn be covered by a mass of more liquid lava, which poured over it from above. And thus "the current had all the appearance of a huge heap of rough and large cinders rolling over and over upon itself by the effect of an extremely slow propulsion from behind. The contraction of the crust as it solidified, and the friction of the scoriform cakes against one another, produced a crackling sound. Within the crevices a dull red heat might be seen by night, and vapour issuing in considerable quantity was visible by day."

The circumstance that Etna uprears its head high above the limit of perpetual snow has a remarkable bearing on the characteristics of this volcano. The peculiarity is touched on by Pindar in the words already quoted, in which he speaks of Etna as "the nurse of everlasting frost concealing within deep caverns the fountains of unapproachable fire." It will be readily conceived that the action of molten lava upon the enormous masses of snow which lie upon the upper part of the mountain must be calculated to produce —under special circumstances—the most remarkable and, unfortunately, the most disastrous effects. It does not always happen that fire and ice are thus brought into dangerous contact. But records are not wanting of catastrophes produced in this way. In 1755, for example, a tremendous flood was occasioned by the flow of the two streams of lava from the highest crater. The whole mountain was at the time (March 2) covered with snow, and the torrent of lava formed by the union of the two streams was no less than three miles in width. The flow of such a mass of molten fire as this over the accumulated snows of the past winter led to most disastrous consequences. "A frightful inundation resulted," says Sir Charles Lyell, "which devastated the sides of the mountain for eight miles in length, and afterwards covered the lower flanks of Etna (where they were less steep), together with the plains near the sea, with great deposits of sand, scoriæ, and blocks of lava."

In connection with this part of the subject may be mentioned the singular and apparently paradoxical circumstance that in 1828 a large mass of ice was found, which had been preserved for many years from melting by the fact that a current of red-hot lava had flowed over it. We might doubt the occurrence of so strange an event, were it not that the fact is vouched for by Sir Charles Lyell, who visited the spot where the ice had been discovered. He thus relates the circumstances of the discovery:—"The extraordinary heat experienced in the south of Europe, during the summer and autumn in 1828, caused the supplies of snow and ice which had been preserved in the spring of that year for the use of Catania, and the adjoining parts of Sicily, and the island of Malta, to fail entirely. Great distress was consequently felt for want of a commodity regarded in those countries as one of the necessaries of life rather than an article of luxury, and the abundance of which contributes in some of the larger cities to the salubrity of the water and the general health of the community. The magistrates of Catania applied to Signor Gemmelaro, in the hope that his local knowledge of Etna might enable him to point out some crevice or natural grotto on the mountain where drift snow was still preserved. Nor were they disappointed, for he had long suspected that a small mass of perennial ice at the foot of the highest cone was part of a large continuous glacier covered by a lava current. Having procured a large body of workmen, he quarried into this ice, and proved the superposition of the lava for several hundred yards, so as completely to satisfy himself that nothing but the subsequent flowing of the lava over the ice could account for the position of the glacier" (in other words, the ice had not accumulated in a cavern of moderate extent accidentally formed beneath overhanging lava masses). "Unfortunately for the geologist," adds Lyell, "the ice was so extremely hard, and the excavation so expensive, that there is no probability of the operations being renewed."

This strange phenomenon is explained, in all likelihood, by the fact that the drift of snow over which the lava flowed had become covered with a layer of volcanic sand before the descent of the molten matter. The effect of sand in resisting the passage of heat is well known. Nasmyth, the inventor of the steam-hammer, illustrated this property in a remarkable manner, by pouring eight tons of molten iron into a cauldron one-fourth of an inch thick, lined with a layer of sand and clay somewhat more than half an inch thick. When the fused metal had been twenty minutes in the cauldron the outside was still so cool that the palm of the hand could be applied to it without inconvenience. And lava consolidates so quickly that there must soon have been formed over the snow a solid covering, strong enough to resist the effects of the fresh molten matter which was continually streaming over it. In this way we may readily conceive, as Sir Charles Lyell has remarked, that a glacier 10,000 feet above the sea-level would endure as long as the snows of Mont Blanc, unless heated by volcanic heat from below.

It is worthy of notice that in the Antarctic seas there is an island called Deception Island, which is almost entirely composed, according to the authority of Lieut. Kendall, of alternate layers of ice and volcanic ashes.

One of the most perplexing subjects to geologists is the existence of so remarkable a valley as the Val del Bove, breaking the contour of the dome of Etna nearly to the summit. It must be remembered that there are few subjects which have been more carefully examined than the question of the formation of valleys and ravines. The primary agent recognised by geologists is the action of subterranean forces in upheaving and depressing the land. In this way, doubtless, all the principal valleys have been formed. But fluviatile influences have also to be considered; and a valley which exists upon the flank of a

mountain may, in nearly every instance, be ascribed to the action of running water.

In the case of the Val del Bove, however, we are forced to come to a different conclusion. If this valley had been formed by the action of running water in some long-past era of the mountain's history, the chasm would have deepened as it approached the base. On the contrary, the precipices which bound the Val del Bove are loftiest at the upper extremity, and gradually diminish in height as we approach the lower regions of the mountain.

Nor can we imagine that the valley has been formed by a landslip. The dimensions of the depression are altogether too great for such an explanation to be available. And, passing over this circumstance, we are met by the consideration that, if the land which once filled this valley had "slipped" (in the ordinary sense of the term), we should see the traces of the movement, and be able to detect the existence of the removed mass. Not only is there no evidence of a motion of this sort, but the slightest examination of the valley at once disposes of the supposition that such a motion can at any time have taken place.

It remains only that we suppose the valley to have been caused by the bodily subsidence of the whole mass which had formerly filled up what is now wanting to the dome-shaped figure of the mountain. And the subsidence must have taken place in a sudden manner—not necessarily in a single shock, but certainly not by a slow process of sinking. For the mass which has sunk is sharply separated from the rest, so that the precipitous walls of the valley exhibit the structure of the mountain's frame to a depth of from 3,000 to 4,000 feet below the summit of the cone. In other words, a portion of the crust has been separated from the rest, and has then sunk bodily down, leaving the remainder unchanged.

When we consider the dimensions of the valley, such an event becomes very startling. "The Val del Bove," says Lyell, "is a vast amphitheatre, four or five miles in diameter, surrounded by nearly vertical precipices." One might almost be prepared to doubt that such a valley as this could be formed in the manner described, were it not that within recent times we have had evidence of the occurrence of similar events. During a violent earthquake and volcanic eruption which took place in Java in 1822, the face of the mountain Galongoon was totally changed, "its summits broken down, and one side, which had been covered with trees, became an enormous gulf in the form of a semicircle. This cavity was about midway between the summit and the plain, and surrounded by steep rocks." Yet more remarkable was the great subsidence which took place in the year 1772 on Papendayang, the largest volcano in the island of Java. On that occasion, "an extent of ground fifteen miles in length and six in breadth, covered by no less than forty villages, was engulfed, and the cone of the mountain lost 4,000 feet of its height."

There is nothing unreasonable, therefore, in supposing that some such event may have resulted in the formation of the strange valley which mars the dome-shaped figure of Mount Etna, although no such events have been witnessed in the neighbourhood in recent times.

One singular feature of the valley remains to be mentioned. The vertical face of the precipices which bound it are broken by what, at a distant view, appear to be dark buttresses, strangely diversified in figure, and of tremendous altitude. On a closer inspection, however, these strange objects are seen to be composed of lava jutting out through the face of the cliffs. Being composed of harder materials than the cliffs, they waste away less rapidly, and thus it is that they are seen to stand out like buttresses. Now, we would invite the close attention of the reader to this part of our subject, because, as it seems to us, it illustrates in a singularly interesting manner the mode in which volcanic cones are affected during eruption.

We have seen that in the eruption of 1811 there was evidence of a perpendicular rent having taken place in the internal framework of Etna, and in 1669 a fissure was formed which extended right through the outer crust. In one case lava was forced through the rent, and burst out at the side of the mountain. In the other, the brilliant light which was emitted indicated the presence of molten lava deep down in the fissure. Now, when we combine these circumstances with the *dykes* seen in the Val del Bove, and with the similar appearances seen round the ancient crater of Vesuvius, we can come, as it appears to me, to but one conclusion. Before and during an eruption, the lava which is seeking for exit must be forced with such tremendous energy against the internal framework of the mountain's dome as to fracture and rend the crust, either in one or two enormous fissures or in a multitude of smaller ones. It does not follow that all or any of the fissures would be visible, because the outer surfaces of the crust may not be rent. Into the fissures thus formed the lava is forced by the pressure from below, and, there solidifying, the crust of the dome remains as strong, after the liquid lava has sunk to its usual level, as it was before the eruption. When we see dykes situated as in the Val del Bove, we learn that the fissures caused by the pressure of the lava extend far down the flanks of a volcanic mountain. That they are numerous is evidenced by the fact that those seen in the Val del Bove amount, according to Sir Charles Lyell, to "thousands in number."

And perhaps we may understand from such considerations as these the manner in which the Val del Bove itself was formed. For a wide strip of country between two great fissures might be so waved and shaken by the action of the sea of molten lava beneath as to be fractured crosswise; and then, on the subsidence of the lava, the whole mass below the fracture would sink down bodily. We gain an extended conception of the energy of the forces which are at work during volcanic eruptions, when we see that they thus have power to rend the whole framework of a mountain.

Among recent eruptions of Mount Etna, one of the most singular was that of the year 1852, which began so suddenly that a party of Englishmen, who were ascending the mountain, and had nearly reached the foot of the highest cone, were only able to escape with great difficulty. The eruption which had commenced so abruptly did not cease with corresponding rapidity, but continued with but few slight intermissions for fully nine months.

In the last week of May, 1879, a fissure opened on the north side of the mountain, and volumes of smoke and flame were seen to issue from it. From the crater itself a great cloud of black ashes was poured forth, "rendering the mountain invisible," said one writer, "and obscuring the rays of the sun" (by which the writer presumably meant obstructing their passage), "even at a distance of many miles. These ashes were carried far and wide, and even covered the ground as far away as Reggio, on the adjacent coast of Calabria. Three new craters opened in the direction of Randazzo, on the north side of the mountain, and the lava ran rapidly towards the town of Francavilla, where great alarm was felt, though that town is situated beyond the river Alcantara, and on the very outskirts of the region usually threatened by eruptions. On the opposite side of the mountain, Palermo and the adjacent villa of Santa Maria di Licodia were also greatly alarmed." The new craters, and the fissure with which the eruption began, lay all on the northern side of the mountain. The stream of lava, which was estimated to be 70 mètres (about 75 yards)

in width, flowed in a direction somewhere between Francavilla and Randazzo, and reached the high road which encircles the mountain, and connects the latter town with the villages Linguaglosso and Piedimonte. These villages were enshrouded in a canopy of ashes, and almost total darkness prevailed in them. None of the ordinary concomitants of a great eruption were wanting. Balls of fire, or what were taken for such, were hurled into the air from the new craters and fissures, and, having reached a great height, they burst with a loud crash. Reports like the rolling of artillery were heard in the night, while night and day alike the stream of lava flowed stealthily and irresistibly on until it reached within a short distance of Linguaglossa.

The terrible but magnificent eruption of the present year tends to confirm the belief of geologists, that, if the earth's internal fires are diminishing in intensity, the diminution takes place very slowly. A process of change may be going on which will result one day in the cessation of all subterranean movements. But the rate at which such a process is going on is so slow at present as to be imperceptible. We cannot point to a time within the historical era, or even within that far wider range of duration which is covered by geological records, at which the earth's internal forces were decidedly superior in energy to those at present in action. Nor is this to be regarded as of evil import, but altogether the reverse. The work achieved by subterranean action, destructive though its immediate effects may often appear, is absolutely necessary to the welfare and happiness of the human race. It is to the reproductive energy of the earth's internal forces that we are indebted for the existence of continents and islands on which warm-blooded animals can live. "Had the primeval world been constructed as it now exists," says Sir John Herschel, "time enough has elapsed, and force enough directed to that end has been in activity, to have long ago destroyed every vestige of land." So that, raising our thoughts from present interests to the future fortunes of the human race, we may agree with Sir Charles Lyell that the most promising evidence of the permanence of the present order of things consists in the fact that the energy of subterranean movements is always uniform, when considered with reference to the whole of the earth's globe.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By Edward Clodd.

X.—EXISTING LIFE-FORMS.

B. *Animals* (continued). IV.—Annulosa.

THE common structural feature which gives its name to the numerous classes of animals, comprising four-fifths of existing species, grouped in this sub-kingdom, is the division of the body into more or less well-defined rings or segments. The nervous system consists of two fine cords knotted at different points by ganglia or masses of nerve-cells, the first pair of ganglia being above the gullet, so that the cords which join the second pair form a collar round it. The important part which the mouth plays as the immediate channel between the animal and its surroundings accounts for the development of the higher organs of communication near it; the anterior or front segments most completely undergo concretion, and in this way the portion that carries the mouth, the chief nervous centre or brain, and the sensory organs, as eyes, ears, antennæ, is formed. Hence the position of the head or skull, as the protecting structure around the more specialised parts, is ruled by the position of the mouth In the annulosa the nerves run along the belly; the heart, which is tube-shaped, lies along the back, and the digestive canal is between them. This arrangement of organs distinguishes all but the very lowest classes, both earth-worms and wasps, leeches and crabs, centipedes and beetles, lobsters and ants. But the advance in complexity of structure—in other words, in division of labour—is especially shown in the more elaborate arrangements for the conveyance of nutrition throughout the body as compared with that exhibited in the lower sub-kingdoms; *e.g.*, in the moneron, food and oxygen enter at any and every part; in the amœba, with its primitive skin, they are driven throughout the body by means of a pulsating vacuole; in the polyp, they are brought by the water which flushes it within and bathes it without; in the sea-urchin and the star-fish the nutriment is carried by the canals in their bodies which communicate direct with the water. But in the higher annulosa the oxygen and food are circulated by a more highly organised fluid called blood, which carries them to every part and likewise removes the waste and effete matter, the immediate motor power by which the blood is driven through the body being the heart, and the aëration of the blood—in other words, the supply of oxygen and the removal of carbonic acid—being effected by its passage through the respiratory organs. Only the back-boned animals breathe through the mouth, the lower animals breathing through pores or sacs in their sides.

The annulosa may be divided into the footless, comprising worms and leeches; and the footed, comprising crabs and other crustacea, spiders, scorpions, centipedes, and all insects. The jointed organs of locomotion known as limbs, and which have been developed from muscle-fibres, are arranged in pairs.

Among the lowest members of the annulosa, and with which almost all the higher animals are more or less connected in descent, are *Vermes* or *Worms*—these including a number of degraded forms which live as parasites inside the bodies of nearly all animals, man having his share of them; whilst among the humbler but highly organised and probably somewhat degraded classes are the minute *Rotifers* (so called from the wheel-like movements of the cilia round the mouth), which can remain for years in a state of suspended animation.

The typical form—head, thorax or chest, and abdomen or belly—of the numerous varieties of the widely diffused *Crustacea*, or hard-shelled class, whose three-lobed ancestors, the trilobites, flourished in the seas of the Cambrian and later periods, is the same, with infinite modifications in detail, as that of the remaining classes, from spiders to ants and beetles. But in *Insects* these three divisions are sharply marked, the chest, to which the legs and wings are attached, and the belly, being sometimes joined by a mere thread, whence the name given to that class—*insecta*, "cut into."

Like the rotifers, with their distinct nervous system, eyes, stomach, and other special organs, insects rebuke the vulgar notion that bigness is greatness, and that wonder is to be proportioned by the size of the thing which arouses it. For the infinitely small is as fully charged with mystery as the infinitely great; the movements of forces and energies in both cell and crystal are more complex than the motions of the giant bodies of the heavens; the ultimate analysis of the atom is more elusive than that of the mass which it makes up.

In the several states of existence, or metamorphosis, as it is called, through which most insects pass—egg, grub, chrysalis, imago; in the beauty and delicacy of their structure, notably in the wings, more perfect for flight than

those of birds; in the infinite division of organs, the spider spinning the six hundred strands of its web from as many teats; the dragon-fly with its twelve thousand eyes, each with its own lens and cone and rod; the caterpillar, with its fifteen hundred air-tubes; we learn that magnitude is not necessary to complexity. In the high nervous organisation of insects and the variety of functions, many of these quasi-human, which they discharge; in the dexterity of their actions, and the manifest adaptation of means to ends; in the social order of certain species, notably the ant-commonwealth with its division of labour, its slave and fighting population, its nurseries for pets and weaklings—a political and industrial order, which has not, like ours, to readjust itself by peaceful or bloody revolutions to changing conditions—we have striking evidence of the inter-relation of all things living, and of the unreality of the distinctions which man has set up between instinct and reason; in fine, evidence of fundamental correspondence between the nervous systems of the lowest and the highest. Complexity, not size; mental, not physical power, mark advance in the organism; and it is in the specialisation of the nervous system, and in the proportion of its controlling centre, the brain, to the rest of the structure, that the mechanical explanation of intelligence lies.* Mr. Darwin remarks that the brain of an ant, which is proportionally larger than that of any other insect, although itself not so large as the quarter of a small pin's head, "is one of the most marvellous atoms of matter in the world, perhaps more so than the brain of a man."

There is much force in the argument that the long period of infancy, with its consequent dependence on parental love and care, through which man, and in lesser degree the highest apes and other animals pass, has tended to develop the feeling of sympathy and its expression in service of the helpless by which the family is knit together, and out of which has grown the social instinct which forms tribes and nations. And the argument does not stop here. The more intelligent the animal the longer is the baby stage, for where there is a complex nervous system its specialisation goes on after birth; whereas in the case of an animal with low capacities all the nervous connexions are formed before birth, so that it begins life in lusty independence, fully equipped for work, and therefore with no tie to bind it to its parents, while its isolated life is fatal to mental development.

Now the ant, with other communal insects, as bees and wasps, has to pass through a relatively long grubhood, and in this we may have the explanation of its high social organisation, which has had measureless time for its development, since the remains of the hymenoptera are found as far back as the Jurassic age, *i.e.* the middle of the Secondary Epoch. And if the argument has any force in the case of man, the evolutionist is bound to apply it to the ant.

But in the highest members of the annulosa we arrive at the extremity of one branch of the life-tree, and we must descend to reach the starting-point which leads us to the loftier branch whose topmost twig is man.

V. Mollusca.—This sub-kingdom, the importance of whose fossil remains has been indicated, includes a wide range of organisms, any common definition of which is difficult. Many of them appear, like the fallen angels, not to have kept their first estate, as, *e.g.*, the lowest class, which resembles polyps and was formerly erroneously grouped with them. In the larger number of molluscs symmetry of form is more the exception than the rule, and, in one class, to be dealt with presently, we have the nearest known ally of the vertebrates.

Some of the mollusca have neither heads nor hearts, or at least quite imperfect ones, others have heads and chambered hearts; some grow together in colonies, others live an independent life; but all are alike soft-bodied, lacking the jointed structure which distinguishes the annulosa. Some, as the sea and land slugs, are naked, although furnished with a delicate shell when young; others have a leathery or gristly covering; the rest, the shell-fish proper, are protected by single or double valves, which in their spiral forms and fadeless colouring sometimes surpass the loveliest flowers, or which, as in the pearl-oyster, yield the lustrous substance which, according to ancient fable, is formed of raindrops falling into the open valve, where some mysterious agency transmuted them. The power of secreting matter from the surrounding water for the construction of their shells is one of the most persistent characteristics of living things, and in all the mollusca the shells (which are not cast periodically, as with the crustacea) are secreted along the surface of the thick flexible skin called the "mantle," the crumpled form of which determines their shape. They range in size from the enormous Tridacna of tropical seas, which sometimes weighs five hundred pounds, to the minute species of our coasts, thousands of which would scarcely exceed an ounce in weight.

The lowest molluscs are the plant-like, fixed *Sea-mats* and *Sea-mosses*; the highest are represented by the Briarean *Cuttlefish*, from the common species of our seas to the octopus with its rudimentary internal skeleton and its chameleon-like power to change its colour; and by the pearly *Nautilus*, the survivor of an ancient family that swarmed in the waters of the Jurassic and Cretacean periods. Between these range the more familiar shell-fish, notably the oyster, which, in common with all bivalves, is headless; and the periwinkle, whose land congener is the air-breathing snail.

But, for the evolutionist, interest in this sub-kingdom centres in the transparent bag-shaped *Sea-squirts*, or ascidians, which, although classed under Tunicata (Lat. *tunica*, a cloak), are entitled to a distinctive place. Most of the species are immobile, attaching themselves to rocks, shells and other objects, sometimes growing separately, sometimes in clusters on a common stem. Of the two openings in their gristly covering, which, by the way, is largely made up of cellulose, a characteristic element in plants, one is the mouth and the other the vent. The mouth opens into a breathing sac, furnished with numerous gill-slits and cilia, and leading through the gullet to the digestive organs—stomach and intestine—which are connected by a sharp bend with the vent, whence the inhaled water, after giving up its oxygen to the blood, is expelled. The heart, a tube-shaped organ, is placed at the lower end of the body-cavity which fills the space around the intestine, and the nervous system, consisting of a single ganglion, lies between the mouth and vent. The position of this ganglion, as will be seen later on, gives an important clue to the connexion between the ascidians and the vertebrates, but still more important evidence as to this is supplied in the early stages of the ascidian's development. In certain species the egg gives rise to a larva resembling the tadpole of a frog, both outwardly and inwardly, a resemblance "reaching absolute identity when we examine the way in which the various organs arise from the primitive egg-cell," the only important difference being that the ascidian has but one eye. The larva of the ascidian and the frog alike possess four structures which are common to every backboned animal at some stage of its development, and the possession of which is explicable only on the theory of the descent of sea-squirts and vertebrates from a common ancestor. These four structures are (1) the throat with its gill-slits; (2) the primitive backbone—a gristly rod called the notochord which is found in no invertebrates except the ascidians; (3) the brain and spinal cord; and

* The proportionate weight of brain to body is, in Fishes, 1 to 5,600; Reptiles, 1 to 1,300; Birds, 1 to 200; Mammals, 1 to 180.

(4) the eye, which is *inside* the brain. In all other animals which have eyes the retina or sensitive part is developed from the outer skin, and its outgrowth from the brain in vertebrates is ingeniously accounted for by Professor Ray Lankester on the theory that the original vertebrate was a transparent animal, through every part of whose clear skin the light passed and acted on the tissues of the inlying brain. But as the skin became tougher and denser, and functions consequently more localised, the eye-bearing part of the brain had to grow outwards till skin-vesicle and brain-vesicle met, and the eye was formed at the surface.

Similar as are the larvæ of the tadpole and the sea-squirt, they diverge at later stages. While the one advances from the fish-like form to the amphibian, exchanging gills and tail for lungs and limbs, and, in fine, epitomising in its development the series of forms through which its ancestors passed, the other fixes itself by the suckers on its head to stone or plant. Tail, notochord, nerve-cord, and eye disappear, the brain remains small, the throat enlarges, the gill-slits increase in number, the skin becomes hard and leathery, and the eyeless, footless thing sinks, as its manufacture of cellulose markedly shows, well-nigh to the plant level, its vegetating mode of nutrition sealing its degeneration.

The tailless amphibian frog and its allies are, however, not among the earliest vertebrates, which without doubt were aquatic, and the more complete evidence of the near relationship of the sea-squirt to them must be sought in comparison between it and the lowest known vertebrate, a small fish called the lancelet or amphioxus. This comparison will be made in the next chapter, with which our survey of past and present life-forms will end.

COAL.

By W. Mattieu Williams.

COMING now to the practical part of the subject—the business of coal-mining—the first step is to find the coal.

In those cases where the seam is known to exist, has been worked in the neighbourhood, this *may* be easy enough, though it does not always follow that it *must* be. I am sorry to be obliged to say that serious frauds are sometimes perpetrated by trading on the gullibility of investors, who are led to believe that because a seam of coal has been successfully worked in certain ground we will call A, and at another place a mile or two away which we will call C, that therefore the same seam exists in the intermediate ground B. This may be the case or it may not.

That it may be the case is obvious enough; that it may not demands some explanation. I have already described ordinary faults, where a down-throw or an up-throw compels the miner to seek for the lost seam either above or below the present workings, and which he finds by ascending or descending to a height or depth corresponding to the amount of displacement. But it must be remembered that coal-seams are usually more or less inclined from the horizontal, in some cases have been considerably tilted, and that a fault may be due to such tilting. It is easy to understand that such a tilting up-throw may expose the broken face of the coal-seam to the air, raise it above the general level of the surface at the time being, as part of an elevated ridge or hill. Subsequent denudation would cut away this elevated portion of the coal-seam altogether, leaving the lower continuation of the inclined strata still below, as well as the down-thrown portion on the other side of the fault. Thus in subsequent geological ages would be found a strip of land barren of coal corresponding with this denuded and reburied ridge, but with the coal-seam on both sides of it. This state of things is not at all uncommon in the much broken coal-fields of North Wales. Where it occurs the Welsh colliers say that "the coal has gone up to the sky," especially if the "farewell rock," the millstone grit, is exposed.

I describe this particularly in order to warn speculative investors against the fraud above alluded to. It is perpetrated by purchasing an old abandoned colliery and the land adjoining at its depreciated value, then issuing a prospectus describing the previous prosperity of the colliery, the quantity of coal formerly raised therefrom per acre, and the remaining acreage of unworked land. A company is "floated," the water pumped out from the old workings, new workings opened just where a little coal was purposely left near to the known fault, shares are run up, the projectors sell theirs, and presently the end of the remnant of coal is reached and described as an unexpected fault. In the worst cases another pit is sunk farther on beyond the fault, and thus the remaining capital of the new company is exhausted. The reopening of an old colliery should never be attempted without the most exhaustive inquiry into the reasons why it was abandoned, and the most convincing proof of the honesty of the experts employed to make the inquiry. An old hand whose name has appeared on the prospectus of previous failures should be especially mistrusted.

Readers may desire to know how a shrewd and honest adventurer, who has discovered, or thinks he has discovered, an unsuspected coal-seam, or a vein of metal ore, is able to turn his discovery to account when the land belongs to somebody else. Does he keep his discovery a secret and buy the land by a roundabout process, or under false pretences, or is there any fair and recognised mode of proceeding? There is, and it is as follows:—

He goes to the landlord, tells him that he has reason to believe that he can find workable coal or ore on a certain part of the landlord's estate, and will undertake the cost and risk of finding and working it on the usual conditions, these being that the landlord shall give the adventurer a "tack-note," or take-note, which is an agreement for a lease with exclusive right to work the minerals specified therein on the payment to the landlord of a certain *royalty* per ton of material raised. But the business of proving the coal, sinking the pit, and opening the workings occupies some time—two or three or more years—during which the adventurer and his associated capitalists are earning nothing for themselves nor for the landlord, but yet are operating upon the surface, doing it some damage as provided for the surface-rights included in the take-note. In order to hasten this preparatory stage and secure the interests of the landlord in case of abandonment of the enterprise, a specified amount of "dead-rent" is charged during this period, with a proviso that if the coal is finally worked the total amount of dead-rent that has been paid shall be credited against the first royalties, no cash for royalties being paid until they have amounted to the already paid dead-rent.

It sometimes happens that an illiterate poor collier is the discoverer or supposed discoverer of the unsuspected seam. He gets the take-note directly or by the aid of a friend, and in some cases sells it for a respectable sum. A case of this kind came under my notice in Flintshire; the take-note was first sold by the collier for 300*l.* to a man of means, who resold it to a wealthy company for 1,000*l.*, or thereabouts.

The mode of proving a coal-seam is first to sink a bore-

hole, carefully examining the material brought up by the boring tools. When I was concerned in such work the old-fashioned tools were used. These being merely "jumpers," or rude chisel-ended rods of iron, which were thumped down, then lifted, turned a little, and thumped down again, they made their way by simply pulverising the rock. The powder was removed at intervals by letting down a tube, dropping it several times until it picked up by wedging inside the pulverised material. This tube is named the "sludger," and it is obvious that a determination of the exact character of the rock by the examination of the powder or sludge is of very questionable reliability. A skilful expert can find almost any kind of rock he pleases, according to orders received. Now, however, the use of the diamond drill or auger has removed this uncertainty, solid cores of rock being brought up, by which the true nature of the strata can be safely identified at every stage. Even with the old boring tools and sludger actual coal could, of course, be distinguished.

Sanguine people sometimes sink a pit at once with full confidence that it must reach the coal. I watched the whole proceeding in one sad experience of this kind, where the pit came upon barren ground, denuded of the expected cannel seam, apparently by such a process as that above described, and subsequently covered up with more than one hundred yards depth of ordinary upper coal measures. As the cost of sinking and lining the pair of pits ran into thousands, the advantage of boring with modern appliances for obtaining demonstrative cores is obvious.

As a further illustration of the dangers of speculative mining, I may describe another case which occurred in the same neighbourhood. A good, honest, intelligent farmer, a tenant on the Leeswood estate in Flintshire, which nearly adjoins that of Hawarden, the scene of Mr. Gladstone's wood-cutting exploits, turned up in ploughing certain fields several lumps of curly cannel. This was in 1863, when there was great excitement in the neighbourhood owing to the extravagant price obtained for this curly cannel on account of its richness as a source of mineral oil. Instead of the ordinary price of coals, six or seven shillings per ton at the pit's mouth, this ran up to as high as thirty shillings. As one or two or three hundred tons per day is not an extravagant output, a net profit of one pound per ton was very tempting. I had just arrived in the neighbourhood; the farmer showed me some of the pieces of cannel he had turned up; there was no mistake about their composition. He obtained a take-note from his landlord, and was nearly ruined, spent his hard-earned savings in struggling to prove the coal-seam, which was not under any part of the farm, although more and more cannel was found in its soil.

I afterwards, during a residence of a few years in the neighbourhood, made a careful study of the details of its geological features, and discovered that the whole country around had been remarkably glaciated, all the lower levels being covered with moraine mounds, the upper denuded of its coal measures, and the millstone grit laid bare. I found great masses of limestone in railway cuttings and embankments many miles away from any limestone rocks, and great sandstone boulders, the subjects of curious legends, standing upon the cultivated soil, or partially buried therein.* The history of these was revealed by the striation and smoothing of one or more of their sides. (I read a paper on the subject to the Geological section of the British Association, 1865, an abstract of which is printed in their report.) When the Wrexham and Mold Railway was in course of construction, boulders of cannel were found in the Alyn valley near to Hope, and the workmen used them for their cooking fires. I succeeded in saving a fragment of one of these, and have it still. The nearest seam of cannel to the place where this was found is more than four miles distant, and between is the Hope Mountain, a mass of millstone grit rising 1,000 feet above sea-level and about 700 feet above the local valleys.

Had I known these facts earlier I might have saved the good farmer from the losses which broke him down. Possibly their publication in Knowledge may save others from similar disaster, as other minerals besides coal have been carried long distances down valleys, over plains, and across mountains by the great glaciers that formerly overspread so large a part of Europe. At any rate, such facts are interesting to all students of the history of our home planet. I am sufficiently irreverent and unlearned to believe that outdoor study of the moraine mounds upon which the trees of Hawarden Park are growing, and of the relations of these to the country around, would be a more healthful recreative study for an overworked statesman than the translating of overdone Homer.

Let us now suppose that a seam of coal is by careful boring fully proved on an estate which has never been worked for coal before, and that the whole estate is to be opened out for working.

The next step demanded is to ascertain the inclination of the seam. This, if corresponding to that of the strata above, is easily determined by what is known of them. To make sure of this, if doubtful, two or more borings may be made, and thus the supposed direction and inclination of the slope may be confirmed. I find that many people—in fact, most people who have not previously given attention to this subject—suppose that the part of the seam nearest to the surface, and the most easily reached, will be first attacked; but the contrary is the case. The very deepest part of the coal on the area to be worked is that to which the pits from which it is worked must, in ordinary cases, be sunk. The reason for this is simple enough.

Ordinary coal measures are water-bearing strata, and if the miner began at the upper part of an inclined seam, he would presently have to dive and to work under water; by beginning at the lower part and making a "sumph," that is, sinking his pit to some depth below the bottom of the seam he intends to work, the water runs down into the sumph, from which he pumps it, and thus the whole seam, so far as he is concerned, is drained for working. Besides this, the trollies that bring the coal to the bottom of the shaft all run down inclined roads when loaded, and up the inclines when empty.

I say "so far as he is concerned," and that he works from the deepest part of his own area, but where others own important parts of the seam above him the conditions become perplexing if there is much water and the cost of pumping is great. He must either pump away his neighbour's water as well as his own, or be "drowned out." The rational and equitable course to be followed in such cases is to pump from below by co-operation; but although man is described in biological classification as *homo sapiens*—as a rational and moral being—he does not always justify such description; and hence there are landlords even in England who leave the coal upon their estates unworked rather than subscribe their fair share towards co-operative drainage of the whole field, hoping that some neighbour lower down in the seam will do for them what the industrious and thrifty ratepayer does for the lazy, improvident, or incapable inmates of the union workhouse. These greedy would-be pauper landlords have,

* On the Ordnance map of Flintshire is the name "Garreglwyd" (the grey stones), near to Padeswood Station. Two very remarkable glaciated boulders of millstone grit, that have given this name to the farm, may there be seen standing in a field by the roadside.

however, done some service in checking the rapid exhaustion of our richest coal-fields.

I should add to the above that some coal-seams are dry. These are at present very rare, but will probably become more abundant hereafter, as we proceed deeper and deeper in search of coal. As all the water encountered in sinking coal-pits, wells, &c., is originally derived from the surface, being rain that has penetrated the earth's crust, there is a limit beyond which it does not reach—the which limit is determined by impermeability of strata due to compression and by the continually increasing temperature at increasing depths.

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

IN the series of papers which have appeared under the above heading in these columns we have endeavoured to explain popularly the nature and properties of light, the phenomena of reflection, refraction, interference, and dispersion, the way in which we see, and the source and origin of the innumerable colours which we behold around us. We have endeavoured to simplify our exposition of optical phenomena generally by detailed and illustrated descriptions of apparatus which may be made at home by the veriest beginner; and it now only remains for the editor of this journal to treat, as he has promised, of the spectroscope and its applications, to render these essays tolerably complete as an elementary introduction to the study of optics.

Our object, then, in this concluding chapter is to supplement what we have previously said by an account of two or three pieces of apparatus to which we omitted to refer in the proper places, but which seem calculated to throw a certain amount of light on those branches of the subject which they are especially designed to illustrate. On p. 278 of vol. vi. of Knowledge will be found a description of the action and construction of the stereoscope, and it is there shown how the images of a single object, when sufficiently near to the eyes, are decidedly different as seen by each of them. It is further shown that it is by the convergence of the eyes necessary to bring similar points (dissimilarly situated) into coalescence that the sensation of solidity is produced; that, in fact, in looking at any very distant object the optical axes of the eyeballs are parallel, and that as an object approaches the observer those axes must become more and more convergent. Now, the reader who has thoroughly grasped our explanation will, on a little reflection, see that just as in algebra we can transfer any quantity from one side of an equation to the other by merely changing its sign, so it may be (and, as a matter of fact, it is) possible so to present the two diverse images of a solid body to the eyes as to affect the observer with the belief that he is viewing a hollow one, and *vice versâ*. This is effected by the aid of a very simple instrument, much less known than it deserves to be, and which is known as the pseudoscope. It used to be exhibited at the now defunct Polytechnic Institution. It is represented in plan (or horizontal section) in the subjoined figure.

Here are shown at A and B two prisms placed against a block of wood, about two inches long and one and a half inch wide, cut out in the centre at D to admit the nose. The eyes are supposed to be looking at the globe C in the direction of the arrows. E, E, are brass-plates blackened, which shut out the side light and assist in keeping the prisms in position. A globe viewed through this simple apparatus presents, for a reason which should be now perfectly intelligible, the effect of a concave hemisphere; a hollow tea-cup, on the other hand, standing out as a globe. The effect is very startling, but it sometimes requires a certain amount of gazing to be produced. This pseudo-relief may also be observed by regarding the intaglio crest on a signet ring illuminated by side light, through a lens of an inch focus or so. Almost immediately the intaglio will apparently become a cameo, and the crest will stand up

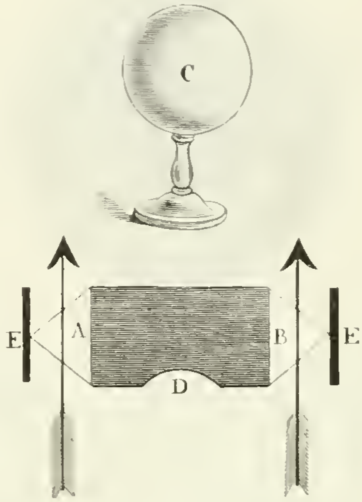


Fig. 1.

above the surface of the stone with startling distinctness. A cognate phenomenon often occurs in viewing lunar craters in a telescope furnished with a solar diagonal eyepiece, and armed with a tolerably high power, under which circumstances the craters put on the appearance of blisters on the face of the Moon, presenting an absurd effect.

In referring to the production of chromatic phenomena in vol. ii. and elsewhere, we omitted to describe two very simple experiments which exhibit them beautifully and effectively. For the first we are indebted to Sir John Herschel, who illustrated the action of minute refracting spheres by mounting the spores of the common puff-ball in a film of oil between two plates of glass. When this arrangement is held close to the eye, and a candle flame viewed through it, beautiful concentric haloes appear. The second little device was the invention of the late Rev. J. B. Reade, and was called by him the "iriscope." He took a circular plate of glass, painted one side of it black, and, after carefully cleaning the other side, rubbed it over with a piece of wet soap. This was, in turn, rubbed off with a clean soft duster. A tube, about half an inch in diameter and a foot long, was held about an inch from the centre of the soaped plate, and the observer blew gently down this tube. The result was that an immense number of minute particles of moisture were deposited on the glass, and these by inflection decomposed the light and produced all the colours of the spectrum.

Proceeding now to our description of Maxwell's discs, and the whirling table on p. 95 of the current volume, we may add that what is done by this piece of apparatus may be as easily effected by the so-called "Gorham's colour top"—a device of that well-known and most ingenious optical physicist, Mr. Gorham, of Tonbridge, whose "pupil photometer" was described on p. 465 of our sixth volume. This is, in fact, nothing more than a top made with a very heavy metal ring, like a gyroscope, on the face of which the Maxwell's discs are laid. By touching the edge of one of them as they rapidly rotate, a varying amount of each

coloured surface is exposed, with the result of notably altering the combined colour. Mr. Gorham also devised an adjunct of the utmost simplicity which gives very pretty results. It consists of a black circular card placed loosely on the stem of the top, above the combination of coloured discs, and having some regular pattern (such, for example, as that shown in fig. 2), cut or punched out of it. A piece

FIG. 2.

of string attached to the periphery of this disc checks its rotation, and causes it to proceed to a certain extent by fits and starts, with the result that the eye looking down upon the black disc sees the pattern beautifully diversified by the colours of the subjacent Maxwell's discs, both separately and in combination. Of course this arrangement can be adapted to the whirling table, too.

Another simple contrivance of Mr. Gorham's to a certain extent performs the work of the double-image prism described on p. 96. This consists of a common pill-box, with small holes pricked through the bottom of it, and covered with films of coloured gelatine. Another hole is pricked centrally in the lid through which the bottom perforations are viewed against a strong light, with the pretty obvious result of causing the diffused coloured discs (produced by viewing the holes at so very short a distance) largely to overlap, and so to exhibit the phenomena of superposed, or rather combined, coloured lights.

Here, then, we terminate our attempt to furnish the student with the means of grounding himself in the elements of physical optics by the aid of apparatus within the reach of everyone. It only now remains for the editor to commence that exposition of "Light-sifting," without which the subject would be left in but an incomplete state indeed.

A LAND OF COLDLESS COLD.—On the island of Chiloe, on the south-west coast of South America, they have 290 cold, rainy days in the year, four-fifths of the rain being mixed with sleet. Yet the natives of that remarkable clime enjoy an equally remarkable immunity from pulmonary disorders. Catarrhs are so nearly unknown that our current theories on the origin of "colds" seem in urgent need of a revision. The latter fact appears to have been recognised now and then. "I shall not attempt to explain," says Benjamin Franklin, "why damp clothes occasion colds rather than wet ones, because I doubt the fact. The cause of 'colds,' I believe, is totally independent of wetness, and even of cold."—*Dr. Felix L. Oswald.*

AN "EVERLASTING" GOOD SHOT.—Jo Brown, one of the Georgia senators, used to be the best shot with a squirrel rifle in the south. His father would give him twelve bullets and tell him to bring in twelve squirrels. "And mind ye," the old man would add, "let the holes be through their 'tarnal heads."

AMERICANISMS.

(*Alphabetically arranged.*)

BY RICHARD A. PROCTOR.

(*Continued from page 276.*)

Evening. In the South and West "evening" runs from noon to sunset, when night begins. It is probable that this is really the older usage. Noon, in fact, marks the evening or equalising of the part of the day passed and the part that is still to come.

Eventuate. To happen. Worcester says the word is "rarely" used by English writers, and Webster says it is "rare" in England. Is it *ever* used, except as slang, by English writers? I have never seen it. Walker does not mention it, not even as a bad word.

Everlasting, everlastingly. The use of these words as intensatives is peculiar to America, and probably, like many other of the profanities of the new country, had its origin in Puritan communities. Just as in many Catholic countries we find references to all that Catholics hold in special reverence used as the most convenient forms for swearing, so in New England, formerly, "tarnation" (for "damnation") was used for extra emphasis. And naturally the adjectives used by religious folk there in cheerful association with "damnation" came also to be favourites with the profane. Since damnation is to be eternal or everlasting, so "eternal" in the form "*tarnal*" was early recognised as a convenient expletive. "Everlasting" took a similar position. "America is an 'everlasting' great country"; "America whipped the Britishers to 'everlasting' smash"; "may I be everlastingly dog-goned," and so forth and so forth—everlastingly.

Every once in a while. Bartlett remarks that this is probably English. He might have written "certainly." "Once now and again" is another English form having the same meaning. The difference between the use of such forms in America and in England is simply in their standing. In England they are used only by the illiterate.

Excellency. A courtesy title given to governors of States. The constitution of Massachusetts allows the title—so that General Benjamin Butler, loved of New Orleans, would now be an Excellency if he had secured a majority over Robinson in 1883. Occasionally its use suggests the *quasi lucus à non lucendo* principle. However, there is probably about as much excellency in the average State governor in America as there is grace in an average duke, or majesty in ordinary kings and queens, or divinity in the kings and queens of two centuries ago.

Excursionist. Bartlett has this word as an Americanism, presumably because it is now used in America in precisely the sense which has long been given to the word in the old country.

Executive, The. Vide *Excursionist.*

Expect, To. Used like "guess," "reckon," "calculate." Webster is very severe on all such mistakes.

Experience. There is a religious use of this word which is, I sincerely trust, an Americanism pure and simple. When a preacher, professional or otherwise, says he is going to tell his "experience" he means that he is going to tell how he "got religion"—another slang expression, which, we may hope, is not English. Statistics tend to show that about nine out of ten who in this sense are ready to tell their "experience" end by getting more than religion, and about five of the nine have to get out. Retired prize-fighters, detected swindlers, repentant convicts, and used-up tipplers are special favourites (not always in America only) when "experiences" are to be related.

Experience Religion, To. To be converted; to discover that the profession of religion is good business. Many in America, as elsewhere, experience religion in the sense in which the man might be said to have experienced honesty, who said—'cutely, if not quite grammatically—"Honesty is the best policy; I say so, and I ought to know, for I've tried both."

Express. This word is always applied in America to the rapid conveyance of goods.

Express-man, Express-office, Express-wagon. Words connected with the express business, and needing no explanation.

Eye-opener. Generally anything which startles; anything which gives a lively expression to the countenance. Hence applied to a specially strong morning drink, the frequent use of which gives to the countenance a specially gloomy aspect.

Eyes, skinned. "To keep the eyes skinned" is a graceful way of expressing lively attention. Occasionally this elegant expression is altered by the substitution of "peeled" for "skinned."

Face the Music, To. Equivalent to the Americanism, "Stand the racket," and the English expression, "Come up to the scratch." Probably the exceeding atrocity of most American bands accounts for the special significance of the expression.

Fair and Square. See *Excursionist.*

Fair off and *Fair up.* Used for "clear off" and "clear up" in the south-western States, applied to the weather only.

Fair Shake. A fair bargain. Described by Bartlett as a "New England vulgarism."

Fall. A common mistake for "fell," as "to fall a tree" for "to fell a tree." Commoner, perhaps, in America than in England.

Fall, for "autumn." A word derived from the old country, but now, unfortunately, out of use among us. Fall and spring match far better than the Latin "autumn" with the Saxon "spring." Webster of old, however, and Annandale of to-day present the word "fall" as good English for autumn; and until Englishmen call spring *ver*, we may still hope that they will return to the good old English "fall."

Fan, Out. To come out (well) in examination. Bartlett thinks the expression derived from a peacock spreading out its tail. Far more probably it is derived from fanning, in the sense of winnowing.

Fancies. A term applied to stocks, the purchaser of which has no means whatever of rightly estimating their value. Used in stock gambling, a method of seeking ruin known outside the States.

INDIAN MYTHS.

By "Stella Occidens."

We have considered the Indian myths regarding the Great Bear. We may now turn our attention to the Little Bear and the Pole Star. The latter must have puzzled the observant Indian, for whilst the rest of the stars were continually shifting their position, this one star remained immovable. The stars were supposed to be animated beings, and as hunting was the usual occupation of the Indians, the stars were principally regarded as hunters. The constellation of the Great Bear represented hunters in pursuit of a bear; whilst the constellation of the Little Bear suggested another party of hunters, guided by the Pole Star. Among the Iroquois traditions is the following myth.

A large party of Indians, whilst in search of new hunting-grounds, wandered on for many moons, finding but little game. At last they arrived at the banks of a great river, entirely unknown to them, where they had to stop, not having the material to build boats. Lost, and nearly famished with hunger, the head chief was taken very ill, and it was decided to hold a council to devise means for returning to their homes. During the dance preceding the council, and while the tobacco was burning,* a little being like a child came to them, and said that she was sent to be their guide. Accordingly, they broke up their camp, and started with her that night. Preceding them with only a gi-wăh, or small war-club, she led them on until daylight, and then commanded them to rest, whilst she prepared their food. They slept, and when awakened by her they found a great feast in readiness for them. Then she bade them farewell, with the assurance of returning to them in the evening.

True to her word, at evening she reappeared, bringing with her a skin jug, from which she poured out some liquid into a horn cup, and bade them each to taste of it. At first they feared to do so, but at last yielding, they began to feel very strong. She then told them that they had a long journey to perform that night. Again they followed her, and in the early morning arrived at a great plain, where she bade them rest again for the day, with the exception of a few warriors, who were shown where they could find plenty of game. Two of the warriors had accompanied her but a short distance when they encountered a herd of deer, of which she bade them kill all they wished in her absence. Again, promising to return at night, she took leave of them. At nightfall she returned, saying her own chief would soon follow, to explain to them how they could reach their homes in safety. In a short time he arrived with a great number of his race, and immediately all held council together, and informed the Indians that they were now in the territory of the pigmies. The latter would teach them a sign already in the sky which would be a sure guide when they lost their way. The pigmies pointed out the Pole star, and told the hunters that in the north, where the sun never goes, while other stars moved about, this particular star would stand still, as a guide to the Indian in his wanderings. They were to follow its light, and they would soon return to their tribe, where they would find plenty of game, &c.

Then they thanked the good pigmies, and travelled every night, until they arrived home safely. When they told all their adventures, the head chief held a meeting of all the tribes, and they resolved to give the star a name. They called it Ti-yn-sōu-dă-go-èrr (the star which never moves), by which name it is known to this day.† Now, in the constellation of the Little Bear there are four stars apart, and three leading directly to the Pole star. The four stars apart were probably the hunters, and the three leading to the Pole star were the two hunters and the child. The pigmies are introduced in the myth because their mission is to help hunters, and we have already observed their close connection with the stars.

As the Indians had observed the stationary position of the Pole Star, so the disappearance for awhile of certain groups of stars attracted attention. Stars which were to be seen in the summer months were no longer visible in winter. The Indians could not account for their absence. In the Hiawatha legends, Schoolcraft relates a Shawnee legend, in which may be recognised a constellation myth.

* The fumes are supposed to ascend as prayers to the gods.

† Smithsonian Institute, "Myths of the Iroquois," p. 59, vol. 1880–81. The above myth is related by Mrs. Erminnie A. Smith, and is translated from the original language. She spent many years among the Iroquois tribes, into one of which, the Tuscarora, she was adopted.

The following is an abridged account of the myth of "The Star Family, or Celestial Sisters." *

Waupee, or White Hawk, was a great hunter. He was tall, and full of life and strength. One day whilst wandering through the forest he suddenly found himself on the borders of a prairie. It was covered with grass and flowers, and presently he noticed a ring worn through the grass without any path leading to or from it in any direction. He determined to hide himself behind some bushes and watch the place.

> Soon he heard, high in the heavens,
> Issuing from the feathery clouds,
> Sounds of music, quick descending,
> As if angels came in crowds.

Looking up he saw a small speck in the sky, which gradually became larger and larger. At last he saw a basket containing twelve beautiful maidens, who leaped out of the basket as soon as it touched the ground. They danced around in the ring, beating time on a silver ball, which made the beautiful music Waupee had heard. He gazed at the fairies in wonder, and at last rushed out from his hiding-place and tried to capture one of them. However, they were too nimble for him, and, leaping into the basket, they were soon on their way to the sky again.

Waupee was vexed, but next day he hid behind the bushes again, and disguised himself as an opossum. The sisters came down again as before; but one, sharper than the rest, saw the opossum creeping towards them. She warned her sisters, and they sprang into the basket, and were soon on their way to the sky. However, when they were half-way up, one of the sisters suggested that perhaps the opossum only wanted to show them how the ball-game was played on earth. "No," said the youngest, "quick, let us ascend."

Next day Waupee changed himself to a mouse, and seeing an old stump of a tree, he moved it near the magic circle, and hid himself inside. When the sisters came down next day, one wiser than the rest noticed the altered position of the stump; but the others, laughing at her, ran around the stump and struck it in fun. Waupee ran out and chased the youngest, whom he caught and carried off in triumph. The rest jumped into the basket, and returned to their home in the skies.

For awhile Waupee was very happy with his beautiful bride, and his joy was increased by the birth of a beautiful son. But his bride became very homesick, and one day when Waupee was out hunting she made a wicker basket, and, going to the magic ring, she got into the basket with her little son, and, singing the magic chant, she soon rejoined her sisters.

Waupee, hearing the music, looked up, and seeing his wife and child ascending in the air, he cried pitifully, and could not be consoled.

After a year had passed, the father of Waupee's bride said to her, "Go, my child, and take your son down to his father, and ask him to come and live with us. Tell him to bring a specimen of each kind of bird and animal he kills in the chase."

Waupee was overcome with joy to see her again, and, hearing her father's message, he hunted for many days. He kept a claw, foot, or wing of every species he captured, and ascending in the basket with his wife and child, he presented them to his father-in-law, the star chief. The latter invited all his people to a great feast, and bade them choose from the collection Waupee had made. As they cho e a wing or a claw, they became animals and ran away. Waupee and his wife and child chose a white hawk's feather.

* Smithsonian Institute, p. 67, 1881.

Gracefully spreading out their white wings, they descended to earth, where the species are still to be found.*

This tribe of Indians possibly accounted in the above way for the disappearance of some constellation. It might have been the constellation Coma Berenices, which is visible during the summer months. It is composed of twelve stars—representing the twelve sisters—and is as much like a basket in shape as the Great Bear is like a bear. Or else the myth may refer to Corona Borealis, which bears a still greater resemblance to a basket during the month of June, though it has not the requisite number of stars. However, in the southern map for July in the editor's "Easy Star Lessons" the constellation resembles a basket, and includes twelve stars and an extra star, which may be Waupee.

* Schoolcraft, "Hiawatha Legends," p. 116.

THE STAR-CLOUDS IN THE PLEIADES.

By RICHARD A. PROCTOR.

AMONG the arguments which I advanced seventeen years ago to show that the various forms of nebulæ or star-clouds visible with telescopic aid in the star-depths belong to our own stellar system, none seemed to me more convincing than the way in which stars and nebulous matter are intermixed in the same region of the heavens.

The association between the stars of our system and the nebulæ long regarded as external universes is shown "most

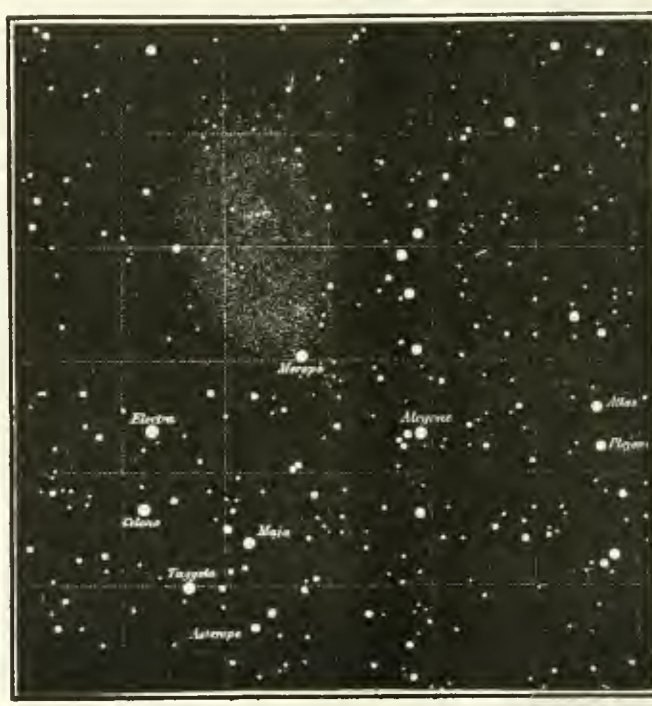


FIG. 1.—MAP OF THE PLEIADES BY TEMPEL, SHOWING THE NEBULA EXTENDING FROM MEROPE, &c.

strikingly," I said in my "Other Worlds," "by the obvious connection between the figure of the irregular nebulæ and the arrangement of the star-groups seen in the same field of view. There is not one of the irregular nebulæ which does not exhibit this peculiarity in the most striking manner.

This may be asserted even of those nebulæ with respect to which Sir John Herschel has remarked that the arrangement may be accidental. His own pictures seem to me to prove in the most convincing manner that no such explanation can be accepted. The mere aggregation of a large number of stars in the very heart of a nebula might be an accident; the fact, for instance, that the great irregular nebula surrounding the star Eta Argûs agrees exactly in position with the greatest condensation of the wonderfully rich portion of the Milky Way on which that surprising variable lies, might be a mere coincidence, though in any case it would be a strange one. But when one examines remarkable nebulous nodules centrally surround two double stars. Admitting the association here to be real, and no other explanation can reasonably be admitted, we are led to interesting conclusions respecting the whole of that nebulous region which surrounds the sword of Orion. We become certain that the other nebulæ in that region are really associated with the fixed stars there; that it is not a mere coincidence, for instance, that the middle star in the belt of Orion is involved in nebula, or that the lowest star is similarly circumstanced. It is a legitimate inference from the evidence that all the nebulæ in this region belong to one great nebulous group which extends its branches to these

Fig. 2.—The Nebula extending from Maia in the Pleiades.
Enlarged from the Photograph.

the structure of this and similar nebulæ, and finds that the stars are arranged in a manner most obviously related to the arrangement of the nebular condensations—or folds, one may almost say—one cannot doubt that a real and intimate bond of association exists between the stars and the nebulous masses around them. If the extension of the milky light of the great Orion nebula to the star ι in the sword, which is centrally involved in strong nebulosity; to ϵ in the belt which is similarly involved; and to several other stars in the constellation, all alike in occupying regions of increased nebular condensation—if this be a mere accidental coincidence, then the laws of probability had better be forgotten as soon as possible, for, as at present understood, they can only serve to lead men astray."

"Amongst other instances," I went on, after referring to illustrations of large nebulæ, "may be cited the nebula round the stars c^1 and c^2 in Orion. In this object two stars. As a mighty hand this nebulous region seems to gather the stars here into close association, showing us in a way there is no misinterpreting that these stars and the nebulæ form one system."

I would invite the astronomical readers of Knowledge to study the photograph of the Pleiades in the June number, comparing it with Tempel's map of the Pleiades (fig. 1 of the present number), and Wolff's chart (fig. 1 of the June number), in connection with the above remarks. We find in the photograph the evidence of the unbiassed eye of photography to show that the nebulous matter in the Pleiades is really associated with certain of the stars in this remarkable star-group. In fig. 2 is shown an enlargement of the nebula, extending from Maia of the Pleiades (see the small chart, fig. 3, in June number, and compare with Tempel's chart, in which Maia appears as Maja).

If anyone looking at these several drawings, considering

the evidence above adduced with regard to the Orion nebula and the nebula in Sagittarius, and further considering the evidence given by the Andromeda nebula recently, and the Argo nebula long since, should retain the opinion that the nebulæ are external star-clouds only seen by accident in optical connection with much nearer stars belonging to our galaxy, there can be nothing to prevent him from rejoicing in such an idea. Certainly no evidence could have any influence in that direction. He could not be convinced though "one rose from the dead," seeing that the orbs of heaven would have spoken in vain for him. Inaptitude such as this for appreciating evidence might not prevent him from being a fairly good astronomer of the surveying sort. But the philosophy of astronomy must ever remain a sealed book to him.

THREE PUZZLES.

(See last Number.)

I. *To arrange nineteen trees, so that they may form nine rows, five in each.*

MARK out the ground as follows:—Let A, D, B, F, C, E, fig. 1, be the angles of a regular hexagon. Join AB, BC, CA, DE, EF, ED, and also DC, AF, EB, intersecting in one point, O. Then if a tree be set at each of the points where the nine lines thus drawn intersect, viz., at A, D, B, F, C, E, at G, H, K, L, M, N, at O, and at P, Q, R, S, T, U, there will be five trees on each line, or nine rows of five trees in each.

The hexagon need not be regular, nor need the figure be in any way symmetrical. But the farmer would naturally prefer to have his ground neatly plotted out.

This puzzle may be extended as follows:—Let C, A, D, B, E be the angles of a regular figure, having $2n$ sides; draw AB and CD, DE cutting, and cutting AB in F and G. Then let straight lines be drawn from C, A, D, B, E to O, the centre of the circumscribing circle (as in fig. 1). This being done from every such angle, as at D, A, B, C, E, &c., it is evident

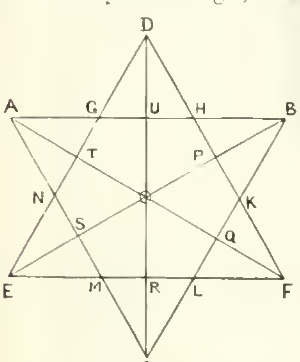


FIG. 1.

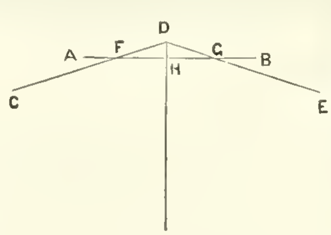


FIG. 2.

that on every such side as AB, DC, CE, &c., there be will be five intersections, and on every line through the centre *four* (for the lines to the centre will give straight lines through the centre), so that the centre itself will make a fifth point precisely as in fig. 1).

Now let us see how many rows of five trees will be formed if a tree is put at each intersection, besides a tree at O; and how many trees will be required:

(1) There are $2n$ sides, and n lines through the centre; that is, there are $3n$ rows in all.

(2) Counting the trees in triplets (as thus in fig. 1—D, H, G; A, T, N; &c.), we see that there are $2n$ triplets; or adding the central tree, the total number of trees is found to be $6n+1$.

Thus the general problem is:

Given $6n+1$ trees it is required to arrange them in $3n$ rows, 5 in each row. (But n must not be less than 3.)

The solution for the general case is indicated in fig. 2.

For the general problem regular figures are not actually required but make a better show than irregular ones, which also cannot be drawn casually. We know that straight lines drawn from the angles of a regular figure of an even number of sides inscribed in a circle will pass severally through the opposite angles. But lines connecting opposite angles (as in fig. 1) of a polygon with an even number of sides will not intersect in a point unless the polygon is either regular, or has its angles set on lines drawn through one point.

The best regular arrangements are obtained from figures inscribed either in a circle or an ellipse. It is only thus that this particular puzzle is associated with the ellipse.

II. *To divide a rectangle (or, if preferred, a parallelogram) into two parts which shall fit so as to form another rectangle.*

We prefer taking the general problem here, showing the limits within which solution is possible.

Let ABCD (fig. 3) be the parallelogram.

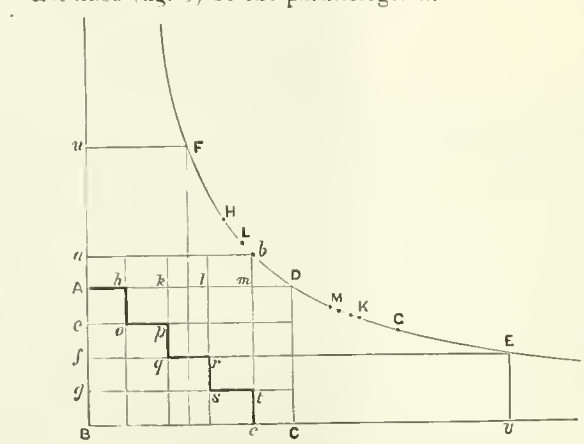


FIG. 3.

Divide AB into any number of equal parts—say, four—at the points *efg*; and divide AD into equal parts, one more in number—or in this case five—at the points *hklm*. By parallels through these points to the sides AB, AD, divide ABCD into equal parallelograms, as shown in the figure. Let ABCD be then divided into parts along the zigzag line *hopqrstc*, and let the portion on the right of this line be shifted to the position A*bs*, as shown in the figure. Then will these two portions form a parallelogram, B*b*.

This puzzle is worth examining geometrically.

It is obvious that the longest parallelogram which can be formed out of AD is obtained by dividing AC into two halves by a line parallel to its longest sides. The parallelogram BE, thus formed, will have its angle at E, where *f*E is twice BC.

Similarly the longest parallelogram in direction BA will be BF, where B*u* = 2BA and BC = 2*u*F.

The next longest either way will have angles at G and H, two-thirds of AB and BC from BC and AB respectively, and *one-half* further than D from BA and BC respectively.

The next will have angles at K and L, *three-fourths* of AB and BC from BC and AB respectively, and *one-third* further than D from AB and BC respectively.

The next will have angles at M and *b*, *four-fifths* of AB and BC from BC and AB respectively, and *one-fourth* further than D from BA and BC respectively.

And so we may pass on from angle to angle, getting successive angles E, G, K, M, &c., $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, &c., &c., of AB from BC, and $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c., &c., further than D from BA; and successive angles F, H, L, *b*, &c., $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, &c., &c., of BC from AB, and $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c., &c., further than D from BC.

The next longest either way will have angles at G and H, further than D from BA and BC respectively.

The next will have angles at K and L, $\frac{3}{4}$ of BC and AB from BA and BC respectively; and $\frac{1}{3}$ further than D from BA and BC respectively.

The next will have angles at M and *b*, $\frac{4}{5}$ of BC and AB from BA and BC respectively, and $\frac{1}{4}$ further than D from BA and BC respectively.

And so we may pass on from angle to angle, getting successive angles $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, &c., of BC and AB from BA BC, and $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, further than D from BA and BC respectively.

By a well-known property of the hyperbola these angles all fall on a hyperbola FDE through D, having BA and BC as asymptotes. The points thus obtained fall nearer and nearer together as the point D is approached.

In the figure the parallelogram BD is rectangular; but it need not be. The construction and comments remain unchanged if BD is rhomboidal.

III. *To inclose ten spaces by six ropes fastened to nine pegs.*

Draw two lines, BA, BC, as in fig. 4, preferably at right angles.

Divide AB into four parts, preferably equal at D, E, F, and

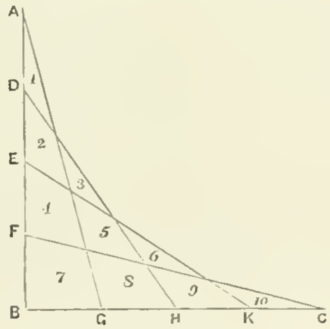


FIG. 4.

BC into four at G, H, K. Put the nine pegs at the nine points thus determined, and stretch the six ropes:—

(1) From A to B;
(2) From B to C;
(3) From A to G;
(4) From D to H;
(5) From E to K; and
(6) From F to C.

In the same way, with four ropes and five pegs, three spaces may be inclosed; with five ropes and seven pegs, six spaces; [with six ropes and 9 pegs, ten spaces]; with seven ropes and eleven pegs, fifteen spaces, &c., &c., and generally—

With $(n+2)$ ropes and $(2n+1)$ pegs $\frac{n}{2}(n+1)$ spaces may be inclosed.

If the figure is drawn symmetrically—that is, BA made equal to BC—and both BA and BC divided into the same number of equal parts, the lines drawn as AG, DH, EK, &c., all touch a parabola whose axis is the bisector of the angle ABC.

If BA and BC are not equal, but divided equally, the lines drawn as AG, DH, EK, &c., all touch a parabola, whose axis is parallel to a line drawn from B to the bisection of AC.

The last two puzzles suggest excellent methods for drawing hyperbolas and parabolas, on which we may hereafter touch.

Here is a puzzle worth working at a little, the solution being instructive as regards the linear and areal proportions of similar figures.

IV. *A farmer's property is in the form of a large ellipse, the farmhouse occupying a space which may be neglected by comparison with the farm, lying outside, but touching the periphery. At his death the farm is to be divided equally between the farmer's three sons, and so that each son shall have access to the farmhouse, but his estate shall be inclosed within a fence having the same length as the circumference of the undivided farm.*

The following puzzles depend on the properties of the stereographic projection:

V. *Draw six circles intersecting each other in eight points at angles of sixty degrees.*

VI. *Draw twelve circles intersecting each other in twenty points at angles of sixty degrees.*

THE NATURALIST'S LABORATORY.

Contribution III.

THE *raison d'être* of a fireplace in the laboratory is obviously to warm the room during the colder periods of the year, but, like the window, it may be made to subserve other duties, and more notably to assist in the thorough ventilation of the apartment. The fireplace cannot, however, be constructed to provide for perfect inlets of fresh air with *economy*, and must therefore fulfil that function only as an adjunct to the ventilating window in small rooms, and to additional special inlets, such as those already described, for large apartments, viz., Boyle's mica flap ventilator, the Sherringham ventilator, and Lamb's air-box. Otherwise an adequate balance cannot be maintained between the fresh air introduced and the vitiated air which is expelled, and it is only by an observance of this grand principle that efficient ventilation can be secured.

A good fireplace for the laboratory, whether constructed to burn solid, liquid, or gaseous fuel, ought to combine many essential qualities. It should warm the room to the normal summer temperature quickly, and be capable of maintaining that degree of warmth without much deviation either one way or the other with a minimum of attention; it should provide for the complete removal of the products of combustion of the fuel in question; it should afford means for an inlet of fresh warmed air to assist in the thorough ventilation of the apartment; but, with all this, it should be economical. It is only within the past few years that this combination of requirements has been attained, and with success proportionate in each variety to the different available forms of fuel. Thus, when wood, peat, coal, and coke are burned in an open grate, a cheap and cheerful * fire is the result, and fireplaces made of stoneware, upon slow combustion principle, with shallow fireclay fuel-holders,

* "Cheerful" is a quality which is wholly dependent upon custom. No one would think of producing a similar optical effect in summer, nor after the transient twilight in the tropics, even though such could be produced without raising the temperature, *e.g.*, by the incandescent electric light specially modified.

fluted hearths, and a special arrangement for the entry of fresh warmed air, as in "Doulton's Syphon-action Ventilating Tile Grate," radiate a maximum of pure heat into the room, from an artistic and pleasing structure, with the only drawback attendant upon the nature of the material consumed, viz., the necessity for frequent removal of ashes, and the consequent dissemination of particles of dirt,* as well as of a tendency to an escape into the room of occasional impurities in the form of finely divided carbon (smoke and soot), carburetted and sulphuretted hydrogen, carbonic acid gas, and water vapour; but these drawbacks are comparatively trivial when expense is taken into consideration. Not, however, when a substitute in the form of a good *stove* is provided, as such an appliance affords all the desirable qualities of the open grate, save the cheerful aspect of the ruddy blaze; but then it has its drawbacks too, in the accumulation of ash, dust and cinders, which, however, can be minimised by the introduction of a suitable collecting receptacle. Such are the qualities embodied in Doulton's really beautiful warming-stove.

Mineral oils may be employed as fuel in place of solid combustibles, but, as somebody has said somewhere, "they are neither fish, flesh, fowl, nor yet good red-herring." They do not warm the apartment equably throughout, and are hence usually made portable, so as to be shifted about, especially if the room happens to be moderately large. It is true that they are cleanly, but that quality alone *versus* inefficient heating, cost of maintenance, the trouble of constant shifting and its inseparable concomitant the impoverishment of the atmosphere through combustion, deservedly dwindles into insignificance. A feeble attempt to imitate the "cheerful blaze" of a coal fire is sometimes made in the shape of an ingeniously-arranged metallic reflector and panes of ruby-coloured glass. They are useful, however, for very small laboratories, such as many a private student of nature can prevail upon the tender-hearted housewife to abandon to him, and the best pattern in the market is, without doubt, that of the "Albion Lamp Manufacturing Company," Messrs. Rippingille & Company, of Birmingham.

Lastly, coal gas may be used as fuel, and here, apart from costliness, is to be found the student's *desideratum*. A gas fire can be arranged to provide a cheery flame; all the products of combustion are most easily removed, fresh warmed air can be as readily admitted, and lateral chambers can be added wherein to do the "cookery of science;" there is no dirt to be removed, with practically no attention to be bestowed upon the maintenance, nay, the accurate regulation, of the warmth in the laboratory; but, alas! all of these advantages are only too often overbalanced by the state of the poor naturalist's exchequer. The name of Fletcher is inseparable from this subject on account of the many forms of heating apparatus which he has invented, and which so justly entitled him to the celebrity he enjoys.

The artificial lighting of the laboratory is not to be commended for careful work, elaborate dissections, observing with the microscope, or in delineating objects. One hour's devotion during the daylight with the clear light reflected from cumular clouds or a bright blue sky is, according to the experience of the majority of persons, positively delightful in contradistinction to the feeling akin to pain engendered by even a few minutes of study with the aid of unnaccustomed, and, *ergo*, unnatural light. Still, there are many cases in which a steady clear lamp or gas flame is able to afford results which cannot so well be attained by daylight; for instance, as in researches respecting the true nature of natural diffraction gratings, *e.g.*, the tests of diatomaceous plants, *Pleurosigma angulatum*, *Amphipleura pellucida*; &c., in continuous investigations into the optical qualities of amplification and resolution in relation to the angular aperture of lenses, the study of the life-history of such minute creatures as *Monads*, &c., all of which make it necessary for the student to employ an unfailing, predirected, and uninterrupted source of light. But these operations are immediately without the limits of this paper, and are only rarely followed by special enthusiasts—Mr. Nelson, Professor Dallinger, Dr. Abbe, and others, whose untiring energy can alone supply them with the necessary "ins and outs" to enable them to prosecute their inquiries with success.

Still, artificial lighting must not be wholly neglected, as it may often be used with great advantage. For occasional work, for displays, and for literary labour, the "midnight oil" will always be welcomed, and, from the nature of the manipulator's occupations, a steady, clear, *portable* light must obviously be the best, so that the employment of mineral oils which have long since superseded animal and vegetable oils, both as regards economy and efficiency, must be preferred to gases as illuminants. The reason for this choice is that, although coal gas has during the past decade been so improved upon that "the amount of sulphur around a gas-burner is, at least in London, less than half what it was a few years ago, there is still, however, a step in advance to be taken, eight or ten grains of sulphur in every 100 cubic feet of gas still to be removed, before gas can claim to be in this respect as perfect a domestic illuminant as candles or oil."* As regards mineral oils, where such are used as heat-givers in addition to their illuminative function, Mr. George J. Snelus says †:—"One difficulty connected with their use for this purpose is that imperfect combustion gives rise to very unpleasant odours; but where combustion is perfect, as in a good Hinks, Silber, or Mitrailleuse lamp, considerable heat as well as light may be obtained at a very small expense, and in a very convenient way. The products of combustion, however, should, if possible, be carried off by special arrangement when large burners are used, although, from their freedom from sulphur, they are not nearly so deleterious as those of gas."

A few observations upon the construction and uses of mineral oil lamps may therefore be noted in this place for the benefit of the student. Captain Shaw's report for 1884 shows that, of the known causes of fires in London, one-fifth can be traced to the overturning or explosion of mineral lamps, as the nature of the volatile liquid is antagonistic to its being heated or exposed to the open air in the presence of flame. Although the flame of a mineral oil lamp cannot be super-heated and its illuminating power increased by being fed with heated air, as in many forms of the gas flame, its careful construction is capable of being so highly utilised that in one lamp called the "Defries' Safety Lamp" (Sepulchre's patent), an average illuminating power of 52·14 standard candles‡ has been registered by a series of careful photometric tests. The lamp is constructed with but a single wick, and, when its candle-power is taken into consideration, it burns less oil than any other lamp yet introduced. Mr. Boverton Redwood's report upon the lamp gives a good idea of the essential requirements of a thoroughly efficient appliance. He says: — "The construction of this lamp is such that neither ignition

* The term "dirt" here must be understood to signify "matter in the wrong place."

* Dr. A. Vernon-Harcourt, Official Catalogue of the International Inventions Exhibition, London, 1885, p. 171.

† "Fuel, Furnaces, etc.," Official Catalogue of the International Inventions Exhibition, London, 1885, p. 184.

‡ "A sperm candle of six to the pound, burning one hundred and twenty grains an hour." Cf. the Metropolis Gas Act, 1860.

of the vapour nor overflow of the oil in the event of the lamp being overturned can occur. Moreover, the oil reservoir, being of metal, is not liable to fracture. . . . The light emitted is remarkably white, the flame is perfectly steady, and the combustion is effected without the slightest odour or smoke." It may be added that the reservoir of ordinary mineral oil lamps ought not to be filled to the brim, the wick should not quite reach to the bottom of the reservoir, the flame on being first lighted should be turned down low and then gradually raised, and, in extinguishing, the wick ought to be lowered and a puff of air sent immediately past the top of the chimney, and not directly down its shaft. If these precautions are taken, the risk from explosions would be practically abolished.

It has been estimated that an ordinary jet of gas, which consumes five cubic feet per hour, deprives the air during that period of all the oxygen from fifty cubic feet of space, and produces five cubic feet of water vapour, besides a small proportion of smoke carburetted and sulphuretted hydrogen; but these deleterious products of combustion can be readily removed through the agency of a special tube placed over the gas flame and leading thence to the external atmosphere; but, of course, such provision has not yet been made for the *portable* laboratory lamp.

Gossip.

By Richard A. Proctor.

I have long felt dissatisfied with what may be called the literature of astronomy, in which we find nothing comparable with the admirable geological works by Lyell, the Geikies (especially Alexander), and others. We have works by the surveying astronomers, who preside at national observatories, and who, though admirably skilful in time measurement and in all the processes of mathematical calculation on which the application of astronomy to commerce (the real object of national observatories) depends, have little insight into the philosophy of astronomy, and, indeed, care little for the science in its nobler aspects. Then we have works written (generally to order) by those who may be called rather the vulgarisers than the popularisers of astronomy.

* * *

On the one hand, specialists, with marvellously exact knowledge of some small department of the science, give us their views—as little satisfactory as would be a description of some great cathedral made by a workman who had passed all his time close by some particular pillar. (The pillar may be very necessary, and, perhaps constitute an important feature of the structure, yet it must obstruct, for one who has stood too closely by it, all view of the proportions of the edifice.) On the other hand, we have writings by men who imagine that a sufficient general view of this noble science can be obtained by a few months' study of other people's work.

* * *

It has long appeared to me that something remained to be done for the literature of astronomy, which, so far as I know, no one has yet attempted, viz.: that one who loved the science should devote many years of time to study its general scope, while yet obtaining such sufficient knowledge of its various parts—observational, mathematical, physical, theoretical, and practical—as to be able to picture these correctly, though in due subordination to the general plan. It may be said that this has been done in Herschel's "Outlines of Astronomy." Sir John Herschel's book comes nearest, indeed, to my idea of what a book on general astronomy should be in order that it may duly instruct and move men's minds—for this, outside its commercial application, I take to be the great purpose and to constitute the chief value of the science of astronomy. But, greatly as I revere the memory of both the Herschels, father and son, I cannot but recognise in John Herschel's "Outlines" a want of symmetry which mars its worth as a work for instructing the world. There are sections, nay, whole chapters, which seem quite out of place in such a work. The last third of the book is, however, very fine.

* * *

Unfortunately Herschel's book is now falling out of date. Astronomy is advancing all the time. It does not require great astronomical discoveries to carry it forward—though, of course, they do so. The advance constantly taking place in our knowledge of physical laws enables us to view astronomical problems with constantly increasing clearness of perception.

* * *

Then astronomy, like other sciences, has gained greatly—perhaps it has gained more than all other sciences—from the growth of men's ideas as to the range of law alike in time and space. Greatly as the astronomy of Newton differed from that of Ptolemy (nay, even from that of Copernicus and Kepler), it did not differ so much from the earlier astronomy as the astronomy of our own time, recognising laws of evolution and development operating throughout all space and throughout all time, differs from the astronomy of Newton's time. *Then* the recognition of law in God's universe seemed like setting God on one side in the name of law; *now* we find in the doctrine of universal law, operating through periods of time to us practically eternal, and extending throughout what for us is infinity of space, simply the recognition of perfect congruity between the laws of God and the domain alike in space and in time for which those laws were made. We find in ideas once held to be essential to men's right estimate of Deity a want of all proper recognition of what the Power "working in and through all things" and throughout all time must necessarily be. To us the old ideas, for rejecting which we are thought by the weak-minded to be wanting in reverence, would be simply blasphemous: though we admit and feel that respectable persons who still entertain them are not really wanting in respect for that infinite, though (otherwise) unknowable Power.

* * *

If it be asked how we can speak of a power as infinite in the same breath in which we speak of it as unknowable, I reply, "As reasonably as we can speak of yonder star as a sun, far vaster and far mightier than this earth on which we live, in the same breath in which we say that the size and might of that star are unknown and (in all probability) unknowable."

* * *

The doctrine of evolution, which had its origin in the science of astronomy, is held by the shortsighted folk, who look at all science from without, as something dangerous for the world. I should be very sorry to think any doctrine which I know to be sound, and believe to be on its way to admission as universal as that accorded to the astronomy of Newton, can be dangerous for the world. It must be a very weak, or else a very ill-constructed world, if that is the case. If there is any danger, it must be because of the mischievous work of those ignorant fanatics who, in their zeal or their own vain notions, have not been unwilling to

tie their religion, and the religion of those unwise enough to trust in them, to rotten and ill-rooted stumps. If, as false ideas give way, true thoughts are for a time swept away with them, the fault is not with those who displace the false ideas, but with those who have too long persisted in teaching men to put their trust in those mistaken notions.

* * *

So far from admitting that there is danger in modern astronomy, I consider that the science has emphatically religious and moral value. Apart from all other considerations, astronomy, as the science which above all others teaches the prevalence and universality of law, must teach also most strongly what I take to be the most valuable of all lessons for men, "the futility of lawlessness, no matter under what high or seemingly sacred name disguised."

* * *

THOUGH I am a believer to the fullest extent in free trade, regarding protection as a device only fit for nations which have barely emerged from barbarism, I regard the idea underlying fair trade as a sound one. Or, rather, I so think because I am a free trader.

* * *

FAIR trade would be a sure way, in certain cases at any rate, of destroying protection. For example, if England put a five per cent. duty on American grain, the grain States of the West would not long put up with the injustice of a protective system, under which they are already groaning. Free traders who think more of the name than of the thing may be content to wait till Indian grain has killed the American grain trade with Great Britain, and doubtless the injury to America so brought about will be more deadly that way—will, in fact, be irreparable—whereas a retaliatory duty would be but temporary, and need even be little more than a threat. But irreparable mischief to one country means always mischief to other countries too. England, for example, suffers indirectly almost as much as America from the destructive protective system adopted by short-sighted American "politicians."

* * *

AMERICANS are confident that England is too thoroughly committed to free trade to attempt retaliation. But if England recalled how she got free trade she would see the probable efficiency of fair trade measures. For England was herself driven from a protective system scarcely less absurd than the American by the fair trade threats of other countries, among which, by the way, America was the loudest.

* * *

CONSIDERING the sad case of the royal family of Bavaria, we in England may ask (with some right to put the question) whether the royal family of England has escaped the manifold afflictions, bodily, moral, and mental, resulting from the intermarriage of cousins. The English royal family has a tolerably wide range of German cousins, or cousins german, to choose from—though, being itself of full German blood, this indicates small room for escape from the evil effects of inter-breeding. Its German record has not been satisfactory. George I. was a pig-headed bully, and George II. only differed in being rather more so. George III. was never really sane, and often very insane. George IV. was as mean a profligate as the annals of even royal scamps record. Of William IV. the Greville Memoirs show us enough to leave little doubt in any reasonable mind that he was something between George III. and George IV., or, as Sheridan said (when George asked him whether he—Sheridan—was more knave than fool, Sherry walking at the time between George and a companion of no very brilliant mind), he was something between knave and fool. Of course, while William lived, none of those who really knew his nature would venture to say what they thought of him.

* * *

IT is amusing, by the way, to find from the later Greville Memoirs that Albert (the Good) used to get angry when anything was said about the royal family. He wanted to institute a sort of inquisition for the punishment of those who thus offended. Very likely there was enough to anger him. Yet the English people pay a high enough price for the discharge of certain easy duties by their kings and queens; and every Englishman has therefore the right to express an opinion as to the likelihood that these duties will be respectably discharged.

* * *

THE disclosures about the social riots in Chicago reveal depths of brutality such as only the dynamite outrages had before suggested. Many receive with intense annoyance and disgust the doctrine that men are akin to the higher apes, and therefore to all orders of monkeys, and through them to lower races of animals. If you ask why they thus object to the alleged relationship, they speak of the great difference between man and all other animals, in that man possesses reason, can distinguish between right and wrong, has been made in fact but "a little lower than the angels." Kinship with beasts not next door to angels, having no sense of right and wrong, not indeed wicked, but absolutely and necessarily wanting in moral goodness, they regard as degrading.

* * *

IT may be so or it may not be. It may be degrading to be formed of the same materials, to breathe the same air, to feed on the same forms of food, as animals; or, on the other hand, we may be quite mistaken in calling these poor relations of ours common and unclean even when in the same breath we admit that they are our fellow-creatures. But if it is degrading to be akin to apes and monkeys, and through them to other animals, what depth of degradation ought we not, by parity of reasoning, to recognise in our unhappy but unquestionable kinship with creatures who, having reason, having (we may presume) the knowledge of good and evil, are deliberately and of set purpose not only evil but hideously wicked. If, being a little lower only than angels (alas, poor angeldom!), we scorn the thought of being akin to mere animals, how are we to bear the certainty that we are of the very same race as some who are not higher than devils?

* * *

I KNOW, indeed, as little about devils as I know about angels. I take the ways of both on trust. Dante and Milton have given us their ideas about devils, and here and there scattered throughout literature, ancient and middle-aged (but especially the latter), we find ideas thrown out about the manners and customs of the wrong sort of angels. I venture, however, to assert with considerable confidence that if any writer, of prose or poetry, had gone so far as to attribute to the blackest of Satan's crew such unutterable wickedness as the dynamiters and bomb-throwers have displayed in deliberately planning the haphazard slaughter and mutilation of men, women, and children, who had done them and wished them no evil, then that writer would have been justly charged with using tints too hatefully black even for devils.

* * *

HATRED and malice, greed and lust, these as motives to murder, and murders through such motives as these, we can

understand. The world has been familiar with *such* atrocities from time immemorial. But haphazard murder, or attempts to murder, with no other motive but the idiotic notion that by injuring the innocent those hated as imagined wrong-doers may be terrified—this is what, until the last few years, the world had not seen; nor had even the liveliest imagination conceived such horrors.

* * *

Americans, however, are rather amused, if not over well pleased, at the way in which the iniquities of recently-arrived ruffians—aliens and foreigners—are quietly attributed in Europe to American democracy. In America they are attributed, perhaps as absurdly (but perhaps not), to the degrading influences of the monarchical system. To attribute them to American institutions is as preposterous as it would be to attribute political or municipal wrong-doings in America to democracy. This last mistake, by the way, incredible though it may seem, has been made by certain of the more old-fashioned folk in the old country.

Reviews.

Microbes, Ferments, and Moulds. By E. L. Trouessart. International Scientific Series. (London: Kegan Paul, Trench & Co. 1886.)—The subject of M. Trouessart's volume possesses a peculiar interest at a time when we are assured that the researches of Pasteur have resulted in the discovery of a prophylactic against that most dread disease hydrophobia; and when, consequently, the words "microbe," "bacteria," &c., are often heard from the lips of those whose ideas of what they are talking about are of the very vaguest. The task set himself by our author is to give the previously uninstructed reader clear and definite information as to the nature and functions of those microscopic cryptogamous plants which are believed by a large and increasing number of pathologists to be, if not the primary causes, at all events the invariable concomitants of specific forms of disease. This he does with all that clearness and charm of style which distinguish popular French scientific literature, and which suffer nothing in the very excellent rendering of his anonymous translator. Following an introduction, in which the nature and general characteristics of microbes and protista are set forth, come nine chapters:—The first, on Parasitic Fungi and Moulds; the second, on Ferments and Artificial Fermentations; the third, on Microbes, strictly so called, or Bacteria; the fourth, on the Microbes of the Diseases of Domestic Animals; the fifth, on the Microbes of Human Diseases; the sixth, on Protection against Microbes; the seventh, on Laboratory Research and Culture of Microbes; the eighth, on the Polymorphism of Microbes; while the ninth summarises the arguments of those which precede it, and compares the microbian theory with others advanced to explain the origin of contagious diseases. Eight appendices further elucidate points in the text of the first five chapters. If we felt disposed to cavil at M. Trouessart's treatment of his subject, we might be tempted to refer to the manner in which he speaks of things as irrefragably established which, to put it in the most favourable way, are, at least, at present only *sub judice*. To take a single example: he talks (on p. 197 *et seq.*) of the "comma bacillus" as the undoubted proximate cause of cholera, an assertion on the truth of which the very gravest doubt has been thrown by the results of recent investigation and discussion. And so in other cases, he appears to us to make allegations which, if not unwarrantable, are at all events unwarranted in the existing imperfect state of our knowledge. It is notable, too, that practically the only Englishman who gets any credit for the results of his investigations in microbial pathology is Sir Joseph Lister, to whose antiseptic system of surgery, however, he does full justice. But this does not prevent his book being at once readable and valuable to those desirous of obtaining a competent general knowledge of its subject, and it may be safely recommended to all who wish to do so.

Echetlus: Considerations upon Culture in England, by George Whetenall (T. Fisher Unwin), is, without doubt, a most original book, written by a man so far out of joint with the age he lives in that he finds something to condemn in everything in which it triumphs most proudly, from the telegraph, telephone, and railway to the sewing-machine and the School Board, which he, with justice, stigmatises as "a machine for thrusting poor baby-wits of every shape and size through a regulation sieve." He rightly indicates the evils of the examination fever now so rife, and suggests that parents like to see the certificate or diploma as a sort of guarantee that their money has been properly expended on education by "a system which fills the fresh minds of children with surfeit and flatulence of disorderly fact." Though few would be willing to follow Mr. Whetenall, in that the majority would consider his wish to return to a simpler, more arcadian life—abolishing the outcome of recent years in the way of machinery, gas, steam locomotion, cheap literature, &c.—unpractical, his book is by no means despicable, inasmuch as it serves to point out many evils overlooked in the general complacency of the age, and the truth of many of his contentions is beyond question. At a time when the milk-and-water style of composition prevails so extensively as at present the force and vigour of Mr. Whetenall's writing and the eccentricity of his language, which returns to a purer epoch of English literature, render his book welcome to the jaded critic.

Mechanics and Faith: a Study of Spiritual Truth in Nature. By Charles Talbot Porter. (New York and London: G. P. Putnam's Sons. 1886.)—It has been jocularly said that the first Mr. Smith has a tremendous deal to answer for. Upon a cognate principle, we cannot but feel that Professor Drummond incurred a considerable amount of responsibility by publishing his "Natural Law in the Spiritual World;" giving rise, as that work has done, to such numerous imitations, of a more or less weak and wishy-washy character. Beyond the exhibition of an earnest and reverent spirit, we are sorry to say that we can find nothing to praise in this latest attempt at reconciliation. Mr. Porter's style is as dreary and monotonous as his tone is dogmatic, which is saying much. If from the weary mass of iteration and reiteration of which the book consists we endeavour to make a *précis* of his argument, the difficulty is found to be great indeed. Perhaps it may convey some idea of its character, however, if we say that the human mind is (according to Porter) incapable *per se* of apprehending or discovering any physical truth; that mechanical inventors have only proceeded tentatively, and succeeded after failures more or less numerous; and that hence all so-called mechanical discoveries are really revelations! He further denies the existence of reason as a special intellectual faculty, and at the same time claims blind obedience to the teaching of the Bible. How without the prior exercise of reason anyone is to satisfy himself that the Bible must demand such obedience, he fails to inform us. If by carefully weighing the best available evidence a man convinces himself that the Bible is actually the Word of God, then at his peril he neglects to listen to it. If, however, he accepts it simply on account of certain assertions contained in it, without the employment of his

reasoning faculties at all, then upon the same principle he would not be justified in rejecting the Koran, or even the Book of Mormon, as revealed to the Prophet Joe Smith. Our author, from the supreme height of his own infallibility, naturally looks down upon such poor creatures as Tyndall and our other great physicists and men of science, and regards the atomic theory, or the notion of material atoms at all, as a mere figment of the imagination. The entire volume consists of sermonising of a very dreary character, and has been seemingly written under the venerable delusion that a statement is proved if it merely be only repeated often enough.

Solar Heat, Gravitation, and Sun-Spots. By J. H. Kedzie. (Chicago: S. C. Griggs and Co. 1886.)—Mr. Kedzie's ideas may be summarised by saying that he regards the ether which fills all space, and whose undulations become known to us in the form of light, heat, and electricity, as the transmitter of waves from every sun in the universe; such undulations, if we understand him rightly, successively degrading through electricity, light, and heat until, when they become slow enough from the enormous distance through which they have travelled, they become manifest only as mechanical force. When, however, these waves of energy break upon a sun, they are at once converted into heat, and hence, according to our author, the perennial supply of heat to the centre and fountain of our own system. But, further, as these waves of energy are travelling radially—if we may so speak—from the confines of space, some of them must be intercepted by bodies on which they impinge, and any two given bodies (say the sun and the earth) must shield each other, to a certain extent, from the impact of these waves, and so be pushed together. Here is the explanation of the force of gravitation in a nutshell! Why, though, on this hypothesis, *mass* should determine the amount of gravitative power our author does not inform us. It would rather seem that volume, or sectional area, should regulate the force with which two bodies should approach, as the larger the section of any sphere the more undulations it must intercept. Sun-spots, &c., are explained by the shielding of parts of the sun's disc by the planets, and so on. It must not, however, be imagined from this brief *résumé* of Mr. Kedzie's book that he is a mere vulgar paradoxer. Heterodox he may be, but it is abundantly evident that he has devoted an immense amount of thought to the hypothesis which he sustains with unusual force and ability. At all events, his book is worth reading.

The Theory and Practice of the Slide-Rule, with a Short Explanation of the Properties of Logarithms. By Lieut.-Colonel John R. Campbell, F.G.S. (London: E. & F. N. Spon. 1886.)—Assuming the beginner to possess a certain familiarity with elementary algebra, he will find Colonel Campbell an efficient and trustworthy guide to the use of that very handy instrument for approximate calculations, the slide-rule. The author begins by explaining the nature and properties of logarithms, and then goes on to show how the logarithmic scales are divided and used on the ordinary carpenter's rule. In a short chapter Colonel Campbell subsequently describes the construction of the less familiar "circular slide-rule," and concludes his work with an explanation and illustration of a method of making a magic-lantern slide to exhibit the principle and working of the instrument to a large lecture audience. This is a useful little book.

Wit and Wisdom of the Rev. Sydney Smith. Wit and Wisdom of Benjamin Disraeli, Earl of Beaconsfield. (London: Longmans, Green, & Co. 1886.)—Recording the utterances of two men, intellectually wide as the poles asunder, the volumes whose titles head this notice may be regarded as a Thesaurus for the essayist and the public speaker, as well as excellent companions on a railway journey, among the mountains, or by the seaside; since they may be taken up and opened anywhere with the certainty of finding amusement and instruction. Their trivial cost might be mentioned as an additional reason for buying them, but that no such reason is in reality needed.

Plain Talk for Plain People. By John Vaughan. (London: Joseph Toulson. 1886.)—This volume is made up of thirteen sermons apparently preached in the Primitive Methodist Chapel of which their author is pastor. If Mr. Spurgeon or "General" Booth affected written discourses they might purchase (and preach) Mr. Vaughan's with advantage.

Der Bibliothekar. By Gustav von Moser. Edited, with literary introduction and notes, by Franz Lange, Ph.D. (London: Whittaker & Co. and George Bell & Sons. 1886.)—This is the German original of "The Private Secretary," over which so many of those who will read these lines have laughed at the Globe Theatre. The introduction and notes add to its value for the English student of German.

The Kennel Review (London: 95 Strand) addresses all who love and are in communication with dogs, either on terms of intimacy or of merely general acquaintance.

Our Chess Column.

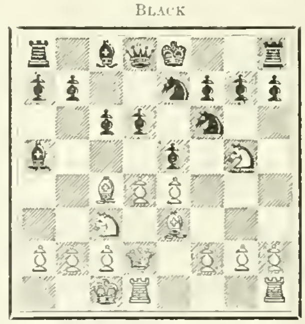
By "Mephisto."

The following games were played in the recent Tournament of the British Chess Association:—

Giuoco Piano.

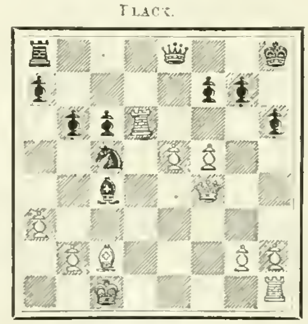
White. I. Gunsberg.	Black. Zukertort.	White. I. Gunsberg.	Black. Zukertort.
1. P to K4	P to K4	17. Kt to R7	R to K sq
2. Kt to KB3	Kt to QB3	18. P to QB4 (*h*)	Kt to Kt5
3. B to B4	B to B4	19. Kt to B6 (ch)	K to R sq
4. P to Q3	Kt to B3	20. Kt × R	Q × Kt
5. B to K3	B to Kt3	21. P to QR3	Kt to B3
6. Kt to B3 (*a*)	P to Q3	22. P to B4	Kt to B4
7. Q to Q2	Kt to K2 (*b*)	23. B to B2	B to K3
8. Castles QR	P to B3 (*c*)	24. R to Q6 (*i*)	P to QKt3 (*j*)
9. P to Q4 (*d*)	B to R4	25. P to B5 (*k*)	B × QBP
10. Kt to KKt5 (*e*)		26. Q to B4 (*l*)	

Black



White.

Black.



White.

10.	P to Q4	26.	B to Kt6
11. P × KP (*f*)	Kt to Kt5	27. R × P (ch) (*m*)	K to Kt sq
12. P × P	Kt × B	28. R to R3	B × B
13. Q × Kt	B × Kt	29. Q to R4	K to B sq (*n*)
14. Q × B	Kt × P	30. P to B6	P × P
15. Q to KKt3	Castles	31. P × P	Kt to Q6 (ch)
16. B to Q3 (*g*)	P to KR3	32. R × Kt	Resigns

NOTES.

(*a*) This move is preferable to 6 P to B 3. If necessary, the Kt, as usual in this opening, may be transferred to the King side via K2 and Kt3. The advantage of this manœuvre, however, has not been reliably demonstrated by practical play.

(*b*) Black might have gained a move by opposing his B on K3.

(*c*) A move of serious consequences for Black. All routine moves do not always hold good, especially when one player varies an opening by adopting a more active line of play. The usual object of playing P to QB3 in this opening by Black is to take advantage of White's early castling on the Q side by playing B to B2, and, after castling KR, to advance the Pawns both in the centre as well as on the Queen's side.

(*d*) This move secures White a considerable advantage; Black has no good reply. If he plays B to B2 White wins a P by 10. P × P, P × P. 11. Q × Q(ch) &c. If Kt to Kt3 Black should likewise maintain an advantage by proper play, *i.e.*:—

9.	Kt to Kt3			
10. P × P	P × P	or	10.	Kt × P
11. Q × Q(ch)	B × Q		11. B × B	Q × B
12. Kt to Kt5	R to Bsq		12. Kt × Kt	P × Kt
13. Kt × BP and wins			13. Q to Q6 with advantage.	

(*e*) Very effective both for defensive and offensive purposes. Black cannot castle now as the following play will show. If 10 . . . Castles, 11. P × P, P × P. 12. Q × Q, B × Q. 13. Kt × BP and wins. Black is compelled to play P to Q4 to protect his KBP.

(*f*) Best, for if Black now replies with P × B, then 12. Q × Q, B × Q. 13. R × B (ch), K × R. 14. Kt × P (ch) and wins.

(*g*) A double-barrelled menace. If Black protects his KRP by P to KKt3, White plays 17. P to QB4, threatening B × KtP, if the Kt moves away.

(*h*) This is better than the possibility of winning the Q by 18. Kt to B6 (ch), Kt × Kt. 19. B to R7 (ch), K × B. 20. R × Q, R × R, Black having three pieces.

(*i*) The R here occupies a commanding position, but the particular object of the move will be apparent in the next few moves.

(*j*) Black could not play B × P at once on account of Q to QB3. This move also gives Black a square for his Kt or Kt2.

(*k*) It is very curious to note the sequence of the moves throughout the whole game, Black hardly having any choice but to submit to White's ideas. P to B5 does not leave Black time to play Kt to Kt 2.

(*l*) White gained an important move by having allowed Black to take the QBP, as this enabled him to attack Black's B and the RP simultaneously, the latter being White's real point of attack from the moment he played R to Q6.

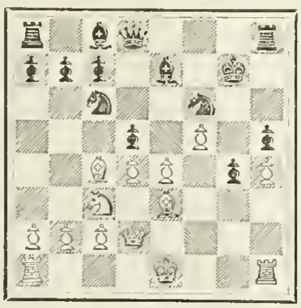
(*m*) Black cannot take the R, for then follows 28. Q × P (ch), K to Kt sq. 29. P to B6, and mates in two.

(*n*) P to B3 would have delayed the finish a little longer.

HAMPE ALLGAYER.

White. I. Gunsberg.	Black. G. H. Mackenzie.	White. I. Gunsberg.	Black. G. H. Mackenzie.
1. P to K4	P to K4	16. Kt × Kt	B × P (ch)
2. Kt to QB3	Kt to QB3	17. K to K2	B × P (*g*)
3. P to KB4	P × P	18. Kt to B3	B to Kt3 (*h*)
4. Kt to KB3	P to K Kt4	19. QR to KBsq (*i*)	B to K2 (*j*)
5. P to KR4	P to Kt5	20. K to Q sq	P to Kt6 (*k*)
6. Kt to K Kt5	P to KR3	21. Kt to Q5 (*l*)	Q to Q2
7. Kt × KBP	K × Kt	22. Kt to B4	Q to Kt5 (ch) (*m*)
8. P to Q4	P to B6 (*a*)	23. K to B sq	B × P
9. P × P	B to K2	24. KR to Kt sq	B to B3 (*n*)
10. B to K3 (*b*)	P to Q3 (*c*)		
11. B to B4 (ch)	K to Kt2		
12. P to B4	Kt to B3		
13. P to B5 (*d*)	P to KR4		
14. Q to Q2 (*e*)	P to Q4 (*f*)		

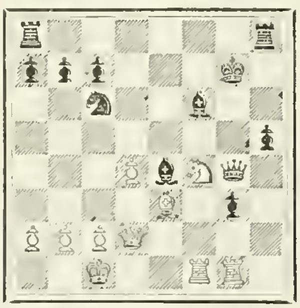
BLACK.



WHITE.

15. B × P	Kt × B

BLACK.



WHITE.

25. P to Q5 (*o*)	Kt to K4
26. K to K6 (ch)	K to B2
27. Q to B3 (*p*)	K to K Kt3
28. B to Q4 (*q*)	Kt to B6
29. B × B	P to Kt7 (*r*)
30. R × P	Resigns.

NOTES.

(*a*) This interesting opening is not often ventured upon by one strong player against another in tournaments. Several moves are available for the defence. Of these moves P to Q4 seems the best.

(*b*) Zukertort suggests 10. B to B4 (ch), K to Kt2. 11. Castles.

(*c*) B × P (ch) deserves preference.

(*d*) This move weakens White's centre. 13. P to Q5 was much stronger. White would gain important time, as the Kt has no good move. If Kt to R4, 14. B to Q3; or if Kt to Ktsq, 14. Q to Q2, followed by 15. Castles QR with a good game.

(*e*) The danger for White is obviously that Black would attack his centre position by P to Q4. The best move now would therefore have been Castles, as thereby the KBP would have been effectually defended.

(*f*) A very judicious advance if now 15. P × P, Kt to R4. 16. B to Q3, Kt × P with advantage.

(*g*) This move gives Black an undoubted superiority.

(*h*) A little more boldness would have secured Black's victory. He ought to have continued B × P. If then 19. Kt × B, R to Ksq, and Black ought to win, for if White defends the Kt by 20. Q to Q3, Kt to Kt5, or if 20. Kt to B2, Kt × P (ch), followed by Kt to B6, wins without much trouble or calculation.

(*i*) A move of great importance for White's future prospects.

(*j*) Necessary in order to free the Queen from her responsibility of guarding the B.

(*k*) By the last two moves White has gained important time to rally his forces for a second attack. P to Kt6 weakens Black's position considerably; his best was probably Q to Q2, and if White then played 21. P to Q5, Black should give up the Kt and play QR to KBsq to avoid the attack following on Kt to K4 by 22. B to Q4, &c. The two passed Pawns ought to win the game.

(*l*) The initiative move of a good attack. If B × P, 22. Kt to B4, threatening Kt to K6, also Kt × P (ch).

(*m*) The White K is safer on QB sq, whereas the Black Q is more precariously posted on Kt5 than on Q2.

(*n*) With every move White's prospects are improving. Black could not now defend his KKtP, for White threatened to win a piece by 25. P to Q5, Kt to K4. 26. Q to Q4, &c; to prevent which Black is compelled to play B to B3. Black never again gets the chance of playing P to R5. It must be noted that neither in reply to check with the white Q nor with the B can Black interpose his B on B3, as White would reply with Kt checks, and then take the B.

(*o*) In reply to this move, Kt to Q sq would result in 26. B to Q4, with a very awkward position, as Black could not defend the B with R to KB sq on account of 27. R × P, Q × R. 28. Kt × P (ch), winning the Q.

(*p*) Every move is full of deep complications. This seems best, although there are other promising moves. The attacked Kt cannot move, for White threatens 28. Q × P (ch), followed by 29. R × P.

(*q*) This move strongly increases the pressure of White's attack, to which Black has no defence if P to R5. 29. B × Kt, B × B. 30. Q × B, with a hopeless position for Black.

(*r*) This, of course, loses. Black might have prolonged the game by playing Kt × R. 30. R × Kt, P to R5. 31. B × R, K to R2. 32. B to B6, &c.

WHIST.

BY "FIVE OF CLUBS."

THE following game is taken from an old number of the *Westminster Papers*, to which it was contributed by Mr. F. H. Lewis, who held hand *B*. It shows how a skilful strategist plays to make a long suit effective when the enemy has equal strength in it. It also affords an admirable illustration of the proper use of false cards, where a partner, by careless play, has rendered such a resource necessary to win or save a game.

THE HANDS.

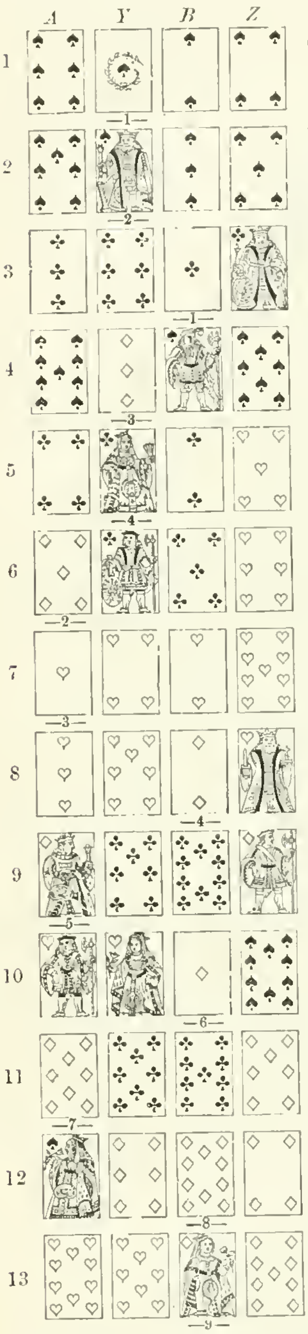
B { D (*trumps*)—A, Q, 10, 2. S.—Kn, 3, 2. H.—2. C.—A, 10, 9, 5, 2. }

Y { D (*tps*).—6, 3. S.—A, K. H.—Q, 8, 7, 4. C.—Q, Kn, 8, 7, 6. }

	B	
Y		Z
	Tr. D. 4.	
	A leads.	

Z { D (*tps*).—4, 7, 9, Kn. S.—4, 5, 8, 10. H.—5, 6, 9, Kn. C.—K. }

A { D (*trumps*).—K, 8, 5. S.—Q, 9, 7, 6. H.—A, Kn, 10, 3. C.—4, 3. }



NOTES ON THE PLAY.

Card underlined wins trick; card underneath leading next.

1 and 2. The Heart Three was the best lead. *Y* would have done wisely to have played the Spade King, and followed with a small Club. He plays, of course, to invite a force from *Z*. But the force comes most effectively and disastrously for *Y–Z* from the enemy. By playing the King and waiting *Y* would not only have retained the commanding Spade, concealing his weakness, but would have played best for the chance of a cross ruff.

3 and 4. *B* seeing that *Y* leads his own long suit, makes the Ace at once, and by forcing *Y* draws him on to give up the command in Clubs Seven. *A* might well have led his Spade Queen, since the Ten probably lies with *Z*. If the Spade Ten had been with *B*, yet *Y* after taking the trick would have had to lead Clubs or Hearts, either of which would have been advantageous for *A–B*. Of course the Heart lead, as events turned out, gave the game to *A–B*, but that proves nothing. *A* had no means of knowing that *B* could ruff Hearts second round, killing the King.

9. As the cards lie, the lead of Diamonds Ten would give the game to *A–B*. But *B* plays best, according to the chances. He knows *Y* holds the two smaller Clubs, and that if *A*, lying over *Z*, can win the trick he will be led through in trumps, which, with the double major tenace, is, of course, what he wants.

10. Here *A* should have led the trump. By leading a Heart he forces *B* (so far as he himself knows) to part with his best trump without drawing any from the enemy. *Z* has no more Hearts, so that *B* is in no better position (as respects *Z*) to a Heart lead than to a trump lead. But a trump lead would have drawn two trumps from *Y–Z*. Even if *Z* had held four and *Y* none, nothing would have been lost by the lead, for one of *Z*'s four trumps would have made in any case. *B* is obliged to play a false card to win the game, which would have been won so simply had *A* led properly. By playing the Ace he hides the position of the Queen and Ten, either or both of which may be with *Y*, or the Ten may be with *A*.

11. But *Y* should have trumped with the Nine. The position is not one for finessing.

12 and 13. *A–B* make three by tricks, which, with two by honours, give them the game.

THE FACE OF THE SKY FOR SEPTEMBER.

By F.R.A.S.

THE sun's disc may still be watched for spots and faculæ, although they are less both in number and frequency. The night sky is shown on map ix. of "The Stars in their Seasons." Minima of the variable star Algol ("The Stars in their Seasons," map xii.) will occur at 10h. 49m. P.M. on the 11th, and on the 14th at 7h. 38m. P.M., as also on other occasions when the phenomenon will not be conveniently observable. Mercury is a morning star all through the month, and may be caught with the naked eye twinkling over the eastern horizon before sunrise. He is at his greatest elongation west of the sun (18° 5′) on the morning of the 2nd. The student who sits up or gets up to watch for the planet may, towards the end of the month, see the Zodiacal light before sunrise, in the east. On the 6th Mercury will be only some 37′ north of Regulus ("The Stars in their Seasons," map v.). Venus, sadly shorn of her glory, may also be seen in the east before sunrise. The night sky is an absolute blank as far as the planets are concerned, all (with the problematical exception of Saturn) being too near the sun to be visible. The moon enters her first quarter at 7h. 55·6m. in the morning of the 5th, and is full at 10h. 50·4m. A.M. on the 13th. She enters her last quarter at 5h. 55·7m. in the early morning of the 21st, and is new at 9h. 18·6m. at night on the 27th. Five stars will be occulted by the moon in September during the ordinary working hours of the amateur observer's night. On the 3rd, γ Libræ, a star of the $4\frac{1}{2}$ magnitude, will disappear at the moon's dark limb at 9h. 19m. P.M., at an angle of 143° from her vertex. The star will have set ere it emerges from behind the bright limb. On the 7th, B.A.C. 6536, a star of the $6\frac{1}{2}$ magnitude, will disappear at the dark limb at 9h. 43m. P.M., at a vertical angle of 65°. It will reappear at the bright limb at 10h. 33m. P.M., at an angle of 353° from the moon's vertex. On the 10th, B.A.C. 7487, another $6\frac{1}{2}$ mag. star, will disappear at the dark limb of the moon at 8h. 11m. P.M., at an angle from her vertex of 129°; reappearing at her bright limb at 9h. 12m. P.M., at a vertical angle of 234°. The next occultation will not occur until the 20th, when 130 Tauri, a star of the 6th magnitude, will disappear at the moon's bright limb at 11h. 34m. P.M., at a vertical angle of 68°. It will reappear at her dark limb at half-past 12, at an angle of 229° from her vertex. Lastly, on the 21st, when the moon rises, the $5\frac{1}{2}$ mag. star, 26 Geminorum, will already have been occulted. It will be seen to reappear at her dark limb later on at 11h. 26m. P.M., at an angle from her vertex of 273°. At noon, on September 1, the moon is in Virgo, 6° north of Spica ("The Seasons Pictured," plate xxv.), and continues in that constellation until the noon of the succeeding day, when she enters Libra ("The Seasons Pictured," plate xxvi.). Passing through Libra, she arrives at 9 A.M. on the 4th on the western boundary of the narrow northern strip of Scorpio, and, after traversing this, at 6 o'clock in the same evening emerges in Ophiuchus. Here she continues until 2 P.M. on the 6th, when she crosses into Sagittarius. She leaves Sagittarius for Capricornus at 3 A.M. on the 9th, leaving that for Aquarius in turn at 2 A.M. on the 10th ("The Seasons Pictured," plate xxi.). Her passage through Aquarius terminates at 9 A.M. on the 13th, at which hour she crosses into Pisces. She is travelling across Pisces ("The Seasons Pictured," plate xxii.). She does not quit the last-named constellation until 3 P.M. on the 16th, and then she passes into the northernmost angle of Cetus. It takes her 24 hours to cross this, and then at the same hour on the 17th she enters Aries. Here she continues only until 8h. 30m. A.M. on the 18th, when she passes into Taurus ("The Seasons Pictured," plate xxiii.). In her journey through Taurus she arrives at 3 A.M. on the 21st at the outlying north-eastern part of Orion. This she takes 12 hours to cross, and at 3 P.M. emerges in Gemini ("The Seasons Pictured," plate xxiv.). At 6 A.M. on the 23rd she passes out of Gemini into Cancer. She leaves Cancer for Leo at 5h. P.M. on the 24th ("The Seasons Pictured," plate xxiv.), and is in Leo until 2h. A.M. on the 27th, at which hour she quits that constellation for Virgo. She crosses from Virgo into Libra at 10h. 30m. P.M. on the 29th ("The Seasons Pictured," plate xxvi.). She is still in Libra when these notes terminate.

CONTENTS OF No. 10.

TERMS OF SUBSCRIPTION.

"KNOWLEDGE" as a Monthly Magazine cannot be registered as a Newspaper for transmission abroad. The Terms of Subscription per annum are therefore altered as follows to the Countries named :

	s.	d.
To West Indies and South America	9	0
To the East Indies, China, &c.	10	6
To South Africa	12	0
To Australia, New Zealand, &c.	14	0

To any address in the United Kingdom, the Continent, Canada, United States, and Egypt, the Subscription is 7s. 6d., as heretofore.

KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART

LONDON: OCTOBER 1, 1886.

THE UNKNOWABLE.

By Richard A. Proctor.

A DIGRESSION CONCERNING THE BUDDHA.

A CORRESPONDENT pleasantly points out what he considers an error in my remarks upon Buddhism in the August number. He says that the Buddha is not held to be a virgin-born saviour, but was "the son of King Suddhodana and Queen Maia, who reigned over the Sakyas. The white elephant which Maia in a dream saw enter her side is understood to be the symbol of the Arahat, that is, of 'one having the perfect wisdom.' So many Buddhist stories," proceeds my correspondent, "have merely a symbolical meaning that it is difficult for an outsider to find the real esoteric doctrine." Regarding me manifestly as very much outside, he directs my attention to the Buddhist Catechism compiled by my entertaining but by no means erudite friend, Colonel Hy. Olcott, president of the Theosophical Society, and to Mr. A. P. Sinnett's "Esoteric Buddhism," by which, he thinks, the Buddhist doctrines will be properly presented to me.

While grateful to my correspondent for his evidently kind intention, I must explain that I should deem it a very serious offence against the readers of Knowledge if I had undertaken to introduce any remarks about so important a subject as Buddhism, the religion of more than one-third of the human race, when so ill-informed that Colonel Olcott's feeble compilation or Mr. Sinnett's borrowed mysticism could be of the least use to me. Colonel Olcott may tell his theosophist followers that Buddha, as he insists on calling Gautama, had "that many disciples," and that Buddhists offer flowers to the statue of Buddha, "but not with the sentiment of the idolator," and otherwise ungrammatically or inexactly catechise them; but every page of his Catechism shows how little he has really studied his subject. Mr. Sinnett is more careful, yet my correspondent will find it well to turn from his pages to some such thoroughly trustworthy work as "Buddhism," by Mr. Rhys Davids.

It is quite true, however, that a religion so widespread as Buddhism, and one which can be adapted (without artifice) to minds of so many varying orders, deserves to be carefully guarded against erroneous ideas. My own belief that Christian doctrines were derived from the East, and are altogether Aryan in origin (their apparent Semitic source being comparable to the apparent origin of a river in a lake which has derived every drop of its waters from snow-clad heights around it), makes me the more careful to explain in what sense I spoke of the Buddha, in the August number, as "a virgin-born saviour." I did, indeed, carefully explain at the time that there was no legend of virgin birth till long after Gautama's death, when his history underwent the usual modification, by which features of the undying solar legend were worked into it. But I will now deal with the point more particularly.

In considering this matter we shall not really be losing ground. For in the first place we have in the history of Gautama the most striking illustration of the adaptation of the solar ideas to the history of a truly great teacher who passed a real though by no means an ordinary life upon earth; and, in the second place, a religion which stands absolutely first in the number of its followers, and can claim very favourable comparison with all other religions alike for the intelligence and character of the races holding it, and for the inherent beauty of its doctrines, deserves full consideration in an essay seeking, as this does, to sketch the search men have made after the unknowable and infinite mystery lying at the back of physical, mental, and moral phenomena.*

The original versions of the story of Gautama were doubtless free from the miraculous and impossible details which appear later. Yet quite early he was regarded as having been absolutely sinless and perfectly wise. Later this developed into the belief that he could not have been born as other men are. For the doctrine that all men born in the ordinary way must of necessity be imperfect is Aryan in origin. (It probably reached Paul of Tarsus, directly or indirectly, from the East; indeed it seems almost impossible to explain the essentially Buddhist doctrines of Semitic religious teachers in the first century of the Christian era in any other way than as derived, with such modifications as were inevitable in such a transfer, from Buddhist sources.) Hence quite naturally arose the teaching that, as Mr. Rhys Davids puts it, "Gautama had no earthly father." "He descended" (according to this later account of him) "of his own accord into his mother's womb from his throne in heaven." "He gave," further, "unmistakable signs, immediately after his birth, of his high character and of his future greatness. Earth and heaven at his birth united to pay him homage; the very trees bent of their own accord over his mother, and the very angels and archangels were present with their help. His mother was the best and purest of the daughters of men,† and his father was of royal lineage, and a prince of wealth and power. It was a pious task to make his abnegation and his condescension greater

* The seeming delay of a month in the appearance of this digressive matter will be explained by certain remarks in "Notes on Americanisms." I do not know that it matters much. The considerations bearing on the religions of the world, and on the search after adequate reasons for ceasing to look for an interpretation of the mystery of the universe, are too numerous to be even touched on in very limited space. I try to give in each contribution matter for independent study.

† I have not found any traces of such further development of the ideas here indicated, as we find in the Catholic doctrine that Mary, the virgin mother of Christ, was born free from the stain of original sin. In Inman's "Ancient Faiths" the doctrine of the Immaculate Conception of Mary is confounded with the doctrine of the Collyridians, that Mary was born of a virgin. The Catholic Church has not taught that. In fact, the danger of such a doctrine (with the manifest sorites which must presently be associated with it—since if there is no difference in this respect between Jesus and Mary, neither should there be between Mary and Anne, or between Anne and *her* mother, and so on indefinitely) would prevent its being ever adopted by adepts in theology. The doctrine of the Immaculate Conception involves no such risk. It teaches only that by divine intervention the stain of Adam's sin, which in all other cases, it appears, marks every child of Adam from the moment of his or her conception, was not suffered to fall on Mary. So far from being a difficult doctrine of Catholicity, this one, viewing the matter entirely from the outside, seems singularly easy to believe: the real difficulty lying not so much in the doctrine that this little Jewess was free from Adam's primeval offence, as in believing that every one else, Jew or Gentile, must be stained by it.

by the comparison between the splendour of the position he was to abandon and the poverty in which he afterwards lived; and in countries distant from Kapilavastu the inconsistencies between such glowing accounts and the very names they contain passed unnoticed by credulous hearers," *—as has happened since.

Hardy mentions in his "Manual of Buddhism," p. 141, the doctrine of the perpetual virginity of Maya. On this point Mr. Rhys Davids remarks, dealing always, however, with ideas which he regards as purely legendary, "As a dāgaba holding sacred relics cannot be used to guard any less sacred object, so 'the Buddha's' mother can bear no other child, and on the seventh day after his birth she dies." There is no historical authority, it need hardly be said, for Maya's death in this manner, any more than there is for her perpetual virginity. But it corresponds well with the solar ideas which had existed for ages before Gautama's time, and were bound in due course to gather around his story when he had been dead long enough for the real facts to be forgotten. For, soon after the birth of the sun-god of the year, the constellation of the Virgin, which had been on the horizon visibly at dawn, was lost in his light. Whether we consider the daily or yearly apparent motion of the sun, the constellation would disappear soon after the appearance of the sun-god—in one case as his light invaded the heavens, in the other as his progress carried him forwards from the constellation, so that when dawn approached the constellation had already set. The interpretation may be varied (but is by no means necessarily done away with) if other natural symbolisms are recognised for Maya. She may represent, as M. Senart suggests, the sovereign creative power, or, as the same writer thinks possible, she may be the half-obscure goddess of the vapours of the morning, dying away from the first hour in the dazzling radiance of her sun. "In reality," he remarks, "she survives under the name of the Creatress, the nurse of the universe," just as Isis survived, and as Mary survives according to Catholic ritual, as Lux perpetua, Turris eburnea, Stella Maris, and, above all, as Regina Cœli —"Queen of Heaven."

Before leaving this point, I may note that as there is abundant authority for one part of the description, "virgin-born saviour," so is there for the other. I cannot do better than quote here the opinion of M. l'Abbé Huc, the well-known French missionary in the East. In speaking of the Buddha he says, "In the eyes of Buddhists this personage is sometimes a man, at others a god. Or, rather, he is both one and the other—a divine incarnation, a man-god, who came into the world to enlighten men, to redeem them, and to point out to them the path of salvation. . . . This idea of redemption by a divine incarnation," adds M. Huc, "is so general and popular among the Buddhists that, during our travels in Upper Asia, we everywhere found it expressed in a neat formula. If we addressed to a Mongol or a Thibetan the question, 'Who is the Buddha?' he would immediately reply, 'The Saviour of Men'" ("Huc's Travels," vol. i., pp. 326, 327). This must have rather startled a Catholic missionary.

MYTHS OF THE SUN-GOD'S BIRTH.

We have now to show that the ancient sun-myths agreed in presenting the three following features:—First, the sun-god was announced by a star; secondly, he was born in a cave; and thirdly, sacrificial offerings were presented to him.

Taking a few of the undoubted representatives of the sun-god, we find Osiris (virgin-born) was announced by a star in the east on December 25, or three days after the winter solstice. He was exposed in effigy to the adoration of the people in the form of a babe lying in a manger (see the "Chronicles of Alexandria," an ancient Christian work *), offerings of precious articles and perfumes being made by the people through the priests or wise men.

Horus, the other Egyptian sun-god, also virgin-born, was in like manner worshipped at Christmas time, his image as a babe being placed in a specially sacred inmost recess of the temple known as the birthplace of Horus. The people passed through the holy adytum to worship before this sacred recess; but at Christmas time the image was brought out of the sanctuary with special ceremonies.

Mithras, the Persian sun-god, whose arrival was announced by a group of stars, was born in a cave or grotto at early dawn. He was visited by Magi, and presented with gifts of gold, frankincense, and myrrh.

Adonis, or Thammuz, was placed in a cave shortly after birth.

Of Apollo and Bacchus, both sun-gods, we have the same account.

Crishna, whose birth had been announced by a special star, was born in a cave and cradled among herdsmen. After his birth the Indian prophet Nared, having heard of his fame, visited his mother and reputed father at Gakool, examined the stars, and declared him to be of divine descent. Crishna received the adoration of the shepherds as a heaven-born child, and was presented with gifts of sandal-wood and perfumes.

The birth of the Buddha (Gautama) was announced in the heavens by an asterism which was seen rising above the eastern horizon. Bunsen tells us it was called the Messianic star, a term no doubt corresponding with the name given by astronomers to the star whose heliacal rising announced the birth of the sun of the new year. He was visited at his birth by a prophet Asita, and by wise men, who hailed him as the God of Gods at dawn. "Asita wept at the thought that he himself was too old to see the day when the law of salvation would be taught by the infant whom he had come to contemplate." † The Buddha's virgin mother, Maia, was on a journey at the time of his birth, and according to one account he was born under a tree, while another assigns an inn as his birthplace. This variety, by the way, characterises many of the stories of the birth of solar gods and heroes; for while Apollo, according to one story, was born in a cave at dawn, according to another he was born under a tree, his mother being on a journey. The same story is told of the birth of Lao-tsze, the Chinese virgin-born Teacher. It may further be remarked that though the Gospel according to Matthew speaks of the birthplace of Christ as a house or inn; while that according to Luke speaks of it as a stable (and alone repeats the story of the taxing, which is taken

* Rhys Davids' "Buddhism," pp. 182, 183.

* Pigord says:—"Deinceps Egyptii parituram Virginem magno in honore habuerunt; quin soliti sunt puerum effingere jacentem in præsepe, quali postea in Bethlehemeticâ speluncâ natus est."

† Jataka, 54. I have quoted from Viscount Amberley's analysis, but would refer the reader to Mr. Rhys Davids' "Buddhism," p. 185. Of course it must be understood that these details gathered only in long later ages around the record of Gautama. As in all other cases in which historic persons have come to be associated with ideas belonging to solar myths, there is not a particle of real evidence in Gautama's case in favour of any events of a supernatural character having attended the conception and birth of the future teacher, or having marked any part of his career even until his death. We have not quite such decisive evidence in his case as we have in later stories (specially in the record of Mahomet) to show that no miraculous events actually marked the career of the teacher. But inasmuch as we have no evidence whatever that such events occurred (for old tales, composed long after all contemporaries had passed away, assuredly do not count as evidence), and as only overwhelming evidence could convince reasoning men that such events were supposed by contemporaries to have happened, we may quite safely dismiss all such stories to their appropriate limbo.

almost bodily from the record of Crishna), the Protevangelion, or First Gospel, attributed to James, the brother of Jesus (before the doctrine of Mary's perpetual virginity had arisen), gives a very full account of the birth of the child in a cave, to which Joseph had been obliged to take Mary, who had been seized with labour pains while on a journey, and to his account the Catholic Church seems still to incline, as any one may learn who will be at the pains to visit a Catholic cathedral at Christmas time.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By Edward Clodd.

XI.—PRESENT LIFE-FORMS.

B. *Animals* (concluded).—VI. Vertebrata.

We now reach the last and highest of the divisions of animal life—the sub-kingdom of the *back-boned*, which includes Man—and when we note the differences between its representative types and those of the divisions below it. all of which include *boneless* animals, we feel that, if there be any break in the continuity of life, it should be found between invertebrates and vertebrates.

Speaking broadly, since the lowest living things have no unlikeness in parts, invertebrates may be said to consist of a single tube or cavity containing the nervous and vascular systems in common, and to have an *outside* skeleton, which is simply a hardening of the skin. In contrast to this, vertebrates consist of two tubes or cavities, the smaller of which encloses the central parts of the nervous system (*i.e.*, the brain and spinal cord), and the other the vascular system (*i.e.*, the organs of digestion and circulation), and they have an *inside* skeleton, the most important part of which is the spine or backbone, which separates the two tubes, and is made up of a number of jointed bones or vertebræ united by remains of the cartilaginous notochord, thus giving flexible action to the whole column. The advantage of this combined strength and ease of movement is seen in fishes as they dart through the water, in the gliding of the snake, the leap of the antelope, and the spring of the lion; while, as compared with animals which are either naked or covered by a rigid horny skeleton, cumbersome as the armour of our ancestors, vertebrates have an enormous superiority in their internal framework of living bone, which adapts itself to, as well as nourishes and protects, the softer parts. Vertebrates are composed of segments placed one behind the other, as in the Annulosa; but the lines of junction have been more or less effaced by structural modification, as, *e.g.*, in the formation of the skull, which is composed of nine or more coalesced segments. The threefold division of the body into head, chest, and belly, so characteristic of shellfish and insects, is, however, more obvious. Wherever limbs are present they never exceed four in number, and are in pairs, whether as fins of fish (not reckoning the unpaired fins as limbs), wings and legs of birds and bats, fore and hind legs of quadrupeds, or arms and legs of man; all being modifications of one type—as, for example, in the framework of the bat's wing, the bones forming which, although immensely prolonged, correspond to our fingers.

Such, in crude outline, are the principal features of the highest animals, but no general description can cover the infinite variety of vertebral forms. Some, as the lancelet and shark, have no bony spine; the frog has no ribs; the tortoise is encased in a shield composed of the hardened skin of its back and belly; and even in the marked division of vertebrates into cold-blooded, embracing fish and reptiles, and warm-blooded, embracing birds and mammals, exceptions occur in warm-blooded fish, as the tunny and the bonito. But no differences in detail can obscure the fact that vertebrates are all modifications of a common type, the variations in structure being due to differences of function determined by unlike modes of life. Obviously the highest types are those in which each organ has only one thing to do, since where one organ has many things to do each is done less completely. Moreover, details obscure relations, and since it is with the relation of all life-forms that we are chiefly concerned, we may pass to further evidence of connexion between the highest invertebrate and the lowest animal of vertebrate character. In water, the population of which far outnumbers that of the land, and the elements of which make up the larger proportion of every plant and animal, life had its beginnings; and it is in water that we find this connecting link in the shape of a semi-transparent creature not more than two inches in length, known as the *lancelet*, from its lance-like shape, and also as *Amphioxus* (Gr. *amphi*, both, and *oxus*, sharp), because both ends are nearly alike. The mouth of this headless, feeble-eyed animal has cilia for driving in the food-carrying water, and opens into a wide gullet through the breathing slits, in which the water, after giving up its oxygen to the colourless blood, passes into the body-cavity, and is expelled at the vent. There being no muscular heart, the blood is circulated by contractions of the vessels.

Now this boneless creature is classed among back-boned animals because it has the primitive gristly rod, called the notochord, from which the spine is developed in all true vertebrates. Above this rod lies the nervous system, composed of a single cord, which bulges slightly as a primitive brain near the mouth. In describing the *sea-squirt*, or *ascidian*, reference was made to its short notochord and single nerve-ganglion, which correspond, as far as they go, to like organs in the lancelet; and if they were lengthened so as to run along the whole of the back of the ascidian, the positions in the two animals would be found to agree exactly. This certainly points to their common descent, and when we compare the embryos and mode of development of both, the evidence will be found complete.

Fishes, as the least specialised vertebrates, are placed in the lowest class, many species, as sharks, rays, and sturgeons, representing in their gristly backbones, uneven tails, and spiny or plated skins, the armoured ganoids of Silurian and Devonian seas, which are the earliest known vertebrate forms and mark the gradations between cartilage and bone in structure. But the vaster number of fishes, perhaps embracing greater variety of form than any other class of vertebrates, are *teleost*, or bony-skeletoned, not breathing—as the worm-like lampreys, hags (in which gristly arches for enclosing the nerves appear on the notochord), sharks, and their allies—through holes or slits in the neck, but through gills.

Just as we had to retrace our steps in search of a link between vertebrates and invertebrates, so we must again go back a step or two to find the intermediate forms between aquatics and amphibians. These forms are represented by certain fishes called *Dipnoi*, or "double-breathers," because, while they have gills for taking up the oxygen from the water, they can also breathe on land by means of the air-bladder or sound, which thus discharges the functions of a lung. Such are the *mud-fish* of the Amazons and the *jeevine* of Australia, both of which show tendency towards modification of the paired fins into limbs, those of the mud-fish being thong-like, and those of the jeevine jointed for locomotion on land. Other fish, as eels and the climbing

perch of India, can also leave the water, but their breathing is effected by special organs connected with the gills.

Here, then, we find the intermediate step between land-dwellers and water-dwellers, the most perfect and familiar example of which is supplied by the common frog's life-history. The gill-breathing, limbless, tailed, plant-eating, aquatic tadpole develops into the lung-breathing, four-legged, web-footed, tailless, animal-eating, amphibian frog, unable, save when torpid, to live in water without coming to the surface for air. Some *amphibians* possess both lungs and gills throughout life, but all the higher vertebrates, whether they live in water or not, breathe through lungs, which arise, like the air-bladder of fishes, as sac-like outgrowths of the primitive gullet.

Reptiles, which include forms as diverse as the nimble lizard, the sluggish crocodile, and the limbless snakes, are for the most part the relatively insignificant descendants of the monsters of the land, air, and water, that flourished in the age of reptiles amidst the dense vegetation of a swampy world until conditions fatal to them, and favourable to the development of higher life-forms, supervened.

Although the exact sequence of *birds* in the appearance of vertebrates is unknown, their descent from reptiles is certain. Not, as might be thought, from the flying species, for these were featherless and more like bats than birds in the membraneous wings which stretched from limb to body, but from species that walked upon the land. But, although structural likenesses between birds and reptiles survive to attest this former close relation, as *e.g.* the union of the skull to the spine by a single joint, instead of by two joints as in most amphibians and in all mammals, and the union of the skull to the jaw by the quadrate bone, which enables the jaws to be opened very widely, manifold causes, working through long periods, have brought about marked differences of external and internal structure. Notable among these is the modification of the three-chambered heart of nearly all reptiles into the four-chambered heart of birds and mammals, by which the fresh and used-up blood are kept separate, and the higher temperature of the body maintained. The scales of the one, and the feathers or furry covering of the other, are alike modifications of the outer skin; for although the intermediate stages between the plumage of birds and the horny plates of reptiles are missing in fossil remains, it is certain that these and kindred structures, as well as claws, nails, and hoofs, are all outgrowths of the skin; even the teeth, the variety of form and arrangement of which renders them of great value in determining the habits and general structure of the animal to which they belonged, being secreted from the skin. It has been shown already that the nerves are also formed from the skin, nor should the variety of function which it discharges, and therefore the variety of structure into which it is modified, surprise us when we reflect how continuous has been the action of the medium with which it is in immediate contact upon the external surface of all organisms, so that the slight film or integument of the lowest has developed into the complex layers which enclose the highest.

Space prevents enlarged reference to the significant proofs of the development of birds as compared with their reptilian ancestors in larger proportion of brain to body, with the intelligence which this connotes, a remarkable proof of which is in the wide range and method of their migrations, involving powers of vision and memory exceeding that possessed by man. On this matter Darwin remarks: "How a small and tender bird coming from Africa or Spain, after traversing the sea, finds the very same hedgerow in the middle of England, where it made its nest last season, is truly marvellous."

The lowest members of the diversified group of *Mammals* or *milk-givers* resemble birds in being toothless, and in having a common sac into which the intestines and other organs open, for which reason they are called *Monotremes* or *one-vented*. These animals are represented by the Ornithorhynchus,* or *Duck-bill*, a beaver-like creature with a horny bill, and feet furnished with both webs and claws, and by the Echidna, or *Spiny Ant-eater*, which resembles a large hedgehog, being snouted and covered with prickles. Each is found in Australia, that land of primitive forms, and recent discoveries invest them with the greatest importance as links in the chain of mammalian descent. For they both lay eggs like reptiles and birds, the duck-bill laying two at a time, which she deposits in her underground nest, and the echidna laying one, which is probably hatched in her pouch. And the eggs further correspond with those of birds and reptiles in having not only the yolk from which the embryo is formed, but the yolk-sac containing the food on which it is nourished until hatched, when it lives on the milk which the mother pumps from her teatless glands until it can shift for itself. Now an animal that unites in itself these reptilian and mammalian features is to be classed among the interesting anomalous and intermediate forms which Darwin has happily termed "living fossils." Whether monotremes are descended in direct line from reptiles, with the internal structure of which they have much in common, and mammals from monotremes; or whether there was an ancestral form or root-stock from which both reptile and mammal branched off, so that mammals are as old as reptiles, and older than birds, is not clear, although the rocks may one day reveal it. But the interrelation of reptiles and mammals is proven beyond question.

The next stage in mammalian development is marked by the *Marsupials* or *pouched milk-givers*, as kangaroos and opossums, the young of which are born in an imperfect condition, and nourished and kept in the mother's pouch till they can run alone. Their fossil remains evidence to a wide range in Triassic times, and the Post-Pliocene beds of Australia yield bones of marsupials as large as elephants; but their habitats are now limited to that island continent and to lands similarly long isolated.

In all other mammals the young are born fully formed, being attached during the time of their development within the mother to a structure called the *placenta*, through which they are nourished by her, whence the general term placental mammals. Starting thus more or less fully equipped in the struggle for life, the chances in their favour were incomparably greater than those of animals which are precariously hatched or born in an imperfect state; hence, among other causes, the dominance of the placentals and their development into the highest organisms yet reached.

They are usually divided into the following classes, which indicate structural characters common to the animals included under each, and not the relative place of any class in the sub-kingdom. No linear arrangement of classes, nor, sometimes, even of species, is possible, for the succession of forms is not as that of steps of a ladder, but as of a many-branched tree.

1. Toothless (*Edentata*) .	Sloths; ant-eaters; armadillos. These show affinities linking them nearer to monotremes than to marsupials.
2. Sirens . . (*Sirenia*)	So-called from their fancied resemblance to mermaids or sirens. Dugongs and manatees, or sea-cows; fish-like in form, the fore-limbs modified into paddles, the hind limbs absent; both of these are flesh-feeders.

* *Ornithorhynchus paradoxus*, the older naturalists named it, for when they were assured that the creature was not a fraud of the stuffer, they thought it must be a freak of nature.

3. Whale-like . (*Cetacea*)	Whales; dolphins; porpoises; also adaptation of structure to aquatic life.
4. Hoofed . . (*Ungulata*)	Very numerous and valuable order. Divided into the *odd-toed*—as the horse, the tapir, and his near relation, the rhinoceros; and the *even-toed*—as swine and their near relation, the hippopotamus; camel; deer; sheep; ox; all these are plant-feeders.
5. Hyrax or Rock-Rabbit . . (*Hyracoidea*)	Represented by a small animal, the coney of the Bible. The shape of the teeth points to affinities between hoofed animals on the one hand and gnawing animals on the other.
6. Trunked . . (*Proboscidea*)	Represented by the elephant, the longest-lived and most acute of plant-feeders.
7. Flesh-feeders (*Carnivora*)	Seals; bears; weasels; wolves and other members of the dog family; lions and other members of the cat family.
8. Gnawers . . (*Rodentia*)	Hare; rat; beaver; squirrel. A very wide-spread class.
9. Insect-feeders (*Insectivora*)	Mole, hedgehog.
10. Finger-winged (*Cheiroptera*)	Bat, highly organised and closely allied to insect-feeders.
11. Lemurs . . (*Lemuroidea*)	The lemurs are sometimes grouped with monkeys in the order of the "four-handed," a division falling into disuse; but they have marked affinities with marsupials, gnawers, and insect-feeders. The "flying lemur," or colugo, a squirrel-like creature with webbed hands, appears to be an interesting link between insect-feeders and primates.
12. Primates . .	Monkeys; baboons; man-like apes (gibbon, ourang-outang, chimpanzee, gorilla), big-jawed, small-brained, stooping posture; Man, big-brained, erect posture—divided into races according to shape of skull, colour of skin, nature of hair.

In the past and present life-history which has been summarised in this and foregoing papers, no break in the continuity of life, or in its fundamental unity, is found. In the unstableness of the first living matter lay the tendency to that variation which, acted upon by manifold agencies in the production of unlikenesses both seen and unseen, has resulted in ever-increasing complexity of forms. But it is not easy, in the disconnected shape in which these papers are presented, to keep clear and constant before the reader the relationship between all life that is and that has been, as well as the identity of that life with, and its dependence upon, the not-living. Perhaps this interrelation may be made more apparent in the exposition of the theory of evolution which is now to follow the description of the things evolved.

End of Part I.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

THE subject of bacteria in connection with health and disease not only continues to occupy the attention and perplex the endeavours of scientific men, but, as articles in the daily papers show, interests a large circle of readers who are too often supplied with statements wide of the true mark. Anybody who has a microscope can easily become acquainted with the leading facts and principles of these researches. A few globules of yeast in a little sugar and water in a small cell placed on the stage of the microscope in a warm room will bud (pullulate) and multiply under the eye of the observer, and, as every one knows, a rearrangement of the molecules of the sugar occurs, resulting in the giving off of carbon dioxyde (carbonic acid) and the formation of alcohol. All fermentations resemble this one of yeast. They are results of a ferment which is a minute plant feeding itself at the expense of the substance fermented, and causing the molecules it does not want for its own subsistence to arrange themselves in new patterns. When beer turns sour little ferments have acted upon the alcohol and made vinegar; when butter turns rancid a ferment has been the cause; and when a bit of meat putrefies other ferments have combined to pull the whole complicated structure to pieces, and all except the mineral constituents are dispersed in the gaseous state.

The products of fermentation may be wholesome, as in the case of leavened bread, or may be highly injurious; and when a physiologist is endeavouring to trace out the cause of an infectious or contagious disorder, he must distinguish between the operation of the microferments themselves and that of the new combinations to which they give rise. If a man gets drunk upon fermenting beer no one accuses the little yeast plants of upsetting his equilibrium, because the specific action of alcohol quite free from yeast is well known. In numerous cases of what are called zymotic diseases the exact chemical change produced by the ferments is not known, and it requires great skill and many trials to find out what the ferments alone can do in the way of injuring healthy animals into whose system they are introduced.

One difficulty occurs at the very threshold of the inquiry. Many little ferments are so commonly and widely disseminated that it needs great care to keep them out. For example, brewers frequently have large quantities of beer spoilt because, besides the yeast ferments which they want, others get in which induce a fresh or destructive fermentation immediately after the yeast plants have caused the right one. Wine-makers are exposed to similar losses, as it frequently happens that they cannot exclude the mischief-makers. In that case Pasteur counselled destroying them by boiling. This saves the wine in a drinkable state, but it will no longer improve by keeping and acquire those aromatic properties known as its *bouquet*.

Many of the disease ferments are difficult to discern with the highest powers, partly from their extreme smallness, and partly from their being of nearly the same refractive power as the fluid in which they are immersed. To make plain this question of refraction to those who have not studied optics, let the difference be noticed between the visibility of a piece of glass immersed in clear water, and the impossibility of recognising a spoonful of water poured into a tumbler of water of the same temperature. A drop of alcohol is distinguishable from water into which it is thrown until it gradually mingles with that fluid and is lost in it. Sometimes a micro-ferment, like the bacterium of tubercular diseases (consumption, &c.), can be made visible by staining with an aniline or other dye. Ferments that are easily seen, and others much more easily not seen, may be in the same fluid, and it has often happened that some experimenter has ascribed to the things he saw the work done by those he did not see, and whose existence he did not suspect. Let us suppose an experimenter has contrived to obtain a pure specimen of fluid containing a specific micro-ferment; his troubles may then begin. To get it in a position ready for the microscope he puts a drop on a glass slide, which ought to be perfectly clean, and not to hold any object that could be mistaken for a micro-ferment. Any ordinary person would be offended if told they could not clean a piece of glass, but making anything perfectly clean is a task requiring considerable manipulative skill. A piece of glass may be washed with strong acid, capable of

destroying most organisms; it may be heated in the flame of a spirit lamp, capable of burning any animal or vegetable substance. It is then presumed to be ready, but the air of the room may deposit some germ upon it; the human breath may do it; it could not be touched on its surface with the cleanest finger without detriment to its complete purity; no instrument such as a glass rod can be safely used to convey the bacterium it is desired to observe and nothing else, unless it has been in the flame of a spirit lamp immediately before its use. Experimenters, like Pasteur, investigating the air of mountain heights, take up with them sterilised fluids fit for the growth of bacteria, &c., in glass bottles, hermetically sealed, and drawn out with narrow necks. They break these necks to let in the air, and then seal them up again with a spirit lamp. But the nippers with which they break the necks may have germs adhering to them, and they must not be used till they have been passed through the hot spirit flame.

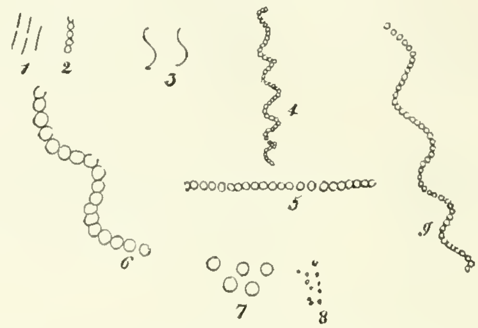
In a case of Dr. Sternberg's his object was to ascertain whether a rabbit was killed by micrococci (round forms of bacteria) or by the poisonous action of the fluid in which they were swarming. He accordingly introduced less than one minim of the fluid with the micrococci in it, with sixty times its quantity of a nutritive fluid, which he had sterilised by heat. He thus grew a fresh crop of the little ferments. Repeating this process eight times, the quantity of the original fluid was lessened each time, until at last it only formed one part in 1,679,611,600,000,000, "yet a few minims of this eighth culture possesses all the virulence of the first." The virulence thus belonged to the micrococci, and not to the original fluid.

In one case of supposed discovery of a ferment of disease the error arose from the glass slide containing in very minute cavities extremely fine particles of rouge used in polishing it, and which were taken for bacteria.

The artificial culture of micro-ferments may be made in infusions of animal or vegetable matter sterilised by heat, or in chemical fluids, such as

Distilled water,	2 c.c.
Phosphate of potash,	0·1 gramme
Sulphite of magnesia,	0·1 „
Tribasic phosphate of lime,	0·1 „

The general student who wishes to understand the nature of micro-ferments, and to appreciate the labours of specialists, can do so without much trouble or inconvenience. An infusion of hay will supply several forms; yeast is easily obtained, and, where there is no handy place to keep offensive putrefying infusions, enough may be done by operating on small quantities, although, as the researches of Dr. Dallinger show, keeping considerable quantities for a long time is the only way of obtaining some forms. As new readers are continually studying the pages of Knowledge, we reintroduce for their benefit some figures which appeared in the number for June 1, 1883. Nos. 1 and 2 represent the bacterium of tubercular disease multiplied respectively about five hundred and one thousand times; 3 is a common form in the scum of infusions; 4, a spirillum considerably magnified; 6 and 9 are other forms; 5, a long bacterian form; 7 and 8, spores and micrococci. Sometimes various little organisms occur in masses of gelatinous matter, which have been called "zooglœa." This happens with many species. The little round forms can only be distinguished from one another by watching their development, which often takes a shape widely differing from the original germ. Dr. Dallinger has traced the existence of whips as motive organs in spirillum and other forms. In many cases this is quite beyond the powers of ordinary students, as it can only be done with very costly objectives and the exercise of long practised and great manipulative skill. In operating with ordinary powers and upon common species, the student must avoid excess of light. It is well to point the microscope so as to receive light direct from a lamp turned edgewise, and through a very small hole of a



diaphragm or condenser, say, one-thirtieth of an inch in diameter.

To counteract the malefic effect of disease-producing ferments there are two courses: one, to kill them by some substance that poisons or otherwise destroys them, the other by rendering the fluid in which they live unfit for their propagation. Acetic acid is reported as having little effect as a germicide. Alcohol also has small value as a germicide. Camphorated alcohol is said by Dr. Sternberg* to be trusted by French surgeons to purify their instruments, although while it kills some mischievous organisms it does not affect others, such as the bacterium of anthrax (wool-sorters' disease). Arsenious acid is not fatal to all forms. Carbolic acid, in the proportion of 1 to 200, destroys *B. termo* and the septic micrococcus in active growth, while 1 : 25 failed to destroy bacteria in broken-down beef-tea. Eucalyptol, the active matter in the blue gum of Australia (*Eucalyptus globulus*), retards, and in some cases stops, the development of bacteria. Ferric sulphate is mostly useless as a germicide, but good as an antiseptic. The same may be said of boracic acid, which, as proposed by Barff, is an excellent preservative of all kinds of food. The heat death-point of these ferments varies greatly; 140° F. will destroy many, but some resist a temperature considerably above the boiling-point of water. Spores of *B. subtilis* in hay infusion are said to withstand boiling for five hours.

A very curious question arises concerning the protective action of inoculation and vaccination. Do they make some permanent change in the vital fluids, or how do they act? Dr. Steinberg says that if the first theory is true, the flesh of a protected animal made into broth ought not to suit the growth of the organism used in the protective inoculation; but this is not sound reasoning, inasmuch as dead broth is not the same thing as the fluids in a live and healthy organism. No conclusive explanation has yet been given.

Poker Pickings.—The judge, the sheriff, the coroner, and the chief of police of Red Gulch, were engaged in playing poker. The pot was pretty large, and considerable excitement was manifested in the outcome. The judge "called" the sheriff, who casually remarked—"I hold four aces. What do you hold?" "I hold a bowie knife," promptly returned the judge, as he perceived a fifth ace in his own hand. "And I hold a six-shooter!" exclaimed the chief of police, as he realised that he was not destitute of aces himself. . . . After an interval of about five minutes the coroner crawled out from under the table, saying—"I hold an inquest, and I guess that takes the pot."

* "Bacteria," by Sternberg.

INDIAN MYTHS ABOUT NIGHT.

By "Stella Occidens."

Indian folk-lore contains many curious myths with regard to night, which differ according to the imaginative powers of each tribe. Some of those here dealt with have been touched on in preceding papers. But in point of fact, such stories present themselves in many different forms.

Among the Algonquins, night is supposed to be a deep and mighty river leading to caverns of darkness, whereas the Dacotah tribes imagine that it is a silver lake leading to the abodes of the blest. The Ottawa tribes believe that night conceals by a veil of darkness a deep chasm which separates the known from the unknown regions; and among the Iroquois night is a dark river, guarded by a wicked magician and serpents. In the Hiawatha legends Longfellow describes it as

> the black pitch-water
> . . . .
> Lighted by the shimmering moonlight.

The Zuni and Oraibi myths are quite unlike the above, as it was a firm belief among these tribes that at one time the earth was always covered by darkness. The Zuni traditions are jealously guarded by the priests, and read aloud every four years in their presence. During a recitation which occurred in February 1881, the following abstracts were made from memory by Mr. Frank H. Cushing. Although greatly condensed, they were pronounced correct by one of the above-mentioned priests.

The account begins with the following characteristic words:—"In the days when all was new, when men lived in the four caverns of the lower regions. In the lowermost one of these, men first came to know of their existence. It was dark: as men increased they began to crowd one another, and were very unhappy." After awhile the "Holder of the Paths of Life," the Sun-father, created two children, whom he sent on earth for the good of men. He gave them a bow (A-mi-to-lan-ne, the Rainbow) and an arrow (Wi-lo-lo-a-ne, Lightning) and a shield of network, in the centre of which was a magic knife. The children were borne down upon the shield net into the caverns where all men dwelt. They listened to the prayers of the priests, and, building a ladder to the roof of the first cave, they widened the hole through which they had come with their magic knife. Later on, men were led into the third cavern, which was still larger, "and like twilight, for the light of the sun himself sifted down through the opening." To these poor children of the dark, the opening seemed like a blazing sun. As time went on, men multiplied as before, and once more prayed for light, and on account of these prayers they at last saw the "light of their father, the sun." *

There is a great resemblance in this myth to the Oraibi myth. The philosopher of Oraibi tells us that when people ascended by means of the magical tree, which constituted the ladder from the lower world to this, they found the firmament (the ceiling of this world) low down upon the earth (the floor of this world). Mateito, one of their gods, raised the firmament on his shoulders, to where it is now seen. Still the world was dark, and the people murmured. Mateito said, "Bring me seven maidens. Bring me seven baskets of cotton-bolls." He taught them how to weave a wonderful fabric, which floated away on the breeze, and became the moon and stars. The people still grumbled because it was cold, so Mateito, sending for buffalo robes, wove a wonderful fabric, which the storm king carried into the sky, and it became the sun.*

The comparison of night to caverns of darkness also occurs in a Micmac legend, concerning Glooksap, who sailed through them in his canoe.

"Now, having made a canoe, the Master (Glooksap) with Marten and Dame Bear, went upon a mighty river. As the story says, it was broad and beautiful at first, and they sailed down towards its mouth. Then they came to great cliffs, which gathered round, and closed over them. But the river ran on beneath these, and ever on, far underground, deeper and deeper in the earth, till it dashed headlong into rapids, among rocks, ravines, and under cataracts, which were so horrible that death seemed to come and go with every plunge of the canoe. And the waters grew narrower and the current more dreadful, and fear came upon Marten and the woman, so that they died. But the Master sat with silent soul, though he sang the songs of magic. So they passed into the night, but came forth again into the sunlight, and there was a lonely wigwam on the bank, into which he bore Marten and the grandmother, saying, "Numchahse!" (which means "Arise!") and lo! they arose, and deemed they had only slept. Glooksap had now gained the greatest power.†

The Algonquins believe that night is a mighty river, and that Manabozho, the Great White One, sailed across it, in pursuit of a wicked magician who had slain his grandfather.‡ This magician lived on the opposite side of the Great Lake, and his wigwam was guarded by a shining Manito and fiery serpents. The Manito was the Great Misshikabikib, the prince of serpents, and the great power of evil. After a desperate struggle Manbozho conquered him, and returned home in triumph. Almost the same account is given of Hiawatha in the Iroquois legends. He, likewise, determines to revenge the death of his grandfather. He sailed away towards the west, and soon he saw the fiery serpents, "breathing fiery fogs," so that none could pass them. Hiawatha destroyed these serpents with his bow and arrows (thunder and lightning). He then smeared the sides of his canoe with oil, so that he might pass the black pitch-water.

> Westward thus fared Hiawatha,
> Toward the realm of Megissogwon,
> Toward the land of the Pearl-Feather.

The magician is overcome by the mighty Hiawatha after a fearful struggle, and then returned—

> Homeward, through the black pitch-water,
> . . . .
> With a shout, a song of triumph.§

An Ottawa legend relates the adventures of five young hunters and a boy about ten years of age, called Ioscoda. They determined to visit the sun and moon. After they had wandered for many days through many lands, and were footsore and weary, they at last saw the spirits Shéshegwun. They were soon overtaken by the darkness, and asked for shelter at a large building on the borders of a mighty plain. Here dwelt a Manito, who gave them shelter, and likewise very good advice when they told

* "Bureau of Ethnology," Smithsonian Institute, p. 13, 1881. (Zuni Fetishes and Customs.)

* "Bureau of Ethnology," Smithsonian Institute, p. 26, 1880.

† Leland, "Algonquin Legends," p. 61. A comparison might be made between the above myth and that of the fish-god Dagon, "who swam nightly through subterranean waters to appear eastward again at daybreak, where he strikes down the oppressor, who has held him in bondage." Fiske, "Myths and Mythmakers," pp. 19, 24.

‡ Brinton, "Myths of the New World," p. 173.

§ Schoolcraft, "Hiawatha Legends," p. 21. This story was related to Schoolcraft in 1882 by the Chippewas of Lake Superior.

him the object of their journey. "Soon after you leave this place you will hear a deafening sound; it is the sky descending on the edge, but it keeps moving up and down. When it moves up, you will see a vacant space between it and the earth. You must not be afraid. A chasm of awful depth is there, which separates the unknown from this earth, and a veil of darkness conceals it. Fear not. You must leap through, and, if you succeed, you will find yourselves on a beautiful plain." All happened as he said, and Iosco and his companion leapt in safety; but two of the hunters who were afraid made a weak attempt. As they jumped, the sky struck the earth with great violence, and they were forced into a black chasm. Those who had reached land in safety found themselves in a beautiful country, lighted by the moon, which they could see approaching from behind a hill, &c.*

NOTES ON AMERICANISMS.

By Richard A. Proctor.

A DIGRESSION, WHICH MIGHT IN PART HAVE BEEN A PREFACE.

A WRITER in the *Saturday Review*, of July 31 (a date which I observe) deals with my "Notes on Americanisms," in the amiable style which that paper affects. The *Saturday Review* too often seems to demand from its writers a touch of personal malignity, not caring particularly whether the feeling has arisen from anger at some real cause of offence or is due to meaner motives. Whether the *Saturday Review* is fair towards me the reader shall judge. For his unfairness my critic may have as an excuse that I have (unwittingly I am sure) offended him; or, as a reason (which would be no excuse), that I have condemned with a deserved severity some offence of his. But he may be merely moved by envy, or (more probably still) he may have received at my hands nothing but kindness, and be angry with me because I have been so far fortunate as to be able to render it to him: I have known such cases.

My critic opens with the remark, by way of a mild jest, that I am somewhat unpatriotic in touching on "Americanisms" just now when the fisheries dispute between the United States and Canada is "in an inflamed condition." In the old country this dispute has not attracted quite so much attention as in the States, or in the States as in Canada—so that the joke falls rather flat. My critic knows pretty well, too, that the "Notes on Americanisms" were begun before the dispute began. I observe his reference to this matter.

He goes on to remark that in my "notes" I reveal my hatred of Poker, which he calls America's national game. One who thus insults America (for Poker is not a game of which American gentlemen are proud) cannot have been born under the Stars and Stripes. I *have* expressed contempt for a game which—*as played for money*—is fit only for horse-thieves and cow-boys. The *Saturday Review* finds here a neat opportunity for somewhat womanish spite. He remarks that I "do well to eschew Poker, since it requires coolness of temper, and knowledge of human nature." Were I as warm as he, I might be excused for retorting, with possibly more truth, that he naturally values Poker, since it requires for success chiefly a false face. Suffice it to remark, however, that I observe this comment on Poker.

Taking in hand my "Notes on Americanisms," my critic remarks, somewhat clownishly, that "Mr. Proctor has been at it again." "With delightful self-satisfaction," he says (I observe this word), I have attacked this subject even as Lord John Russell might have taken command of the Channel Fleet, or have undertaken to write a Zola novel. My want of due modesty is chiefly shown, it appears, by my having originally taken Bartlett's "Dictionary of Americanisms" for my guidance. And because, as I proceeded, I recognised many of the mistakes which (I find) Grant White had also noticed, the *Saturday Review* charges me with absolute want of knowledge as compared with Bartlett's half knowledge.* I should imagine my critic was an Irishman, only I know better.

When I am in doubt about an Americanism I say so ("a virtue that was never seen in" the Hotspurs of the *Saturday Review*). This my critic naturally denounces, presenting it (again *Hibernice*) as part of the evidence of my "delightful self-satisfaction." Take the word a "bit," as used in America. I do not know the true meaning of this word, and I honestly admit as much. *Therefore* the *Saturday Review* snarls that neither do I know the real meaning of many other words I set down. But why did not my critic define "bit"? He *ought* to know what the word really signifies, for he *probably* does not know *too much* about it. During my travels in America I have visited almost every State, and so have heard the word "bit" used in all its various ways, and remain doubtful which has the greatest weight of authority in its favour.

My critic next repeats the weak objection that many of the words included among my "Americanisms" are heard in England, or have been in the past. I repeat (see "Gossip" for April last) "I know it." "I guess" is good old English. I have met with it in at least a score of old English books, from Chaucer to Locke, yet even my critic would hardly deny, I suppose, that to say "I guess." is now distinctly an Americanism. So with "I reckon," "I calculate," and the rest. So also with the expressions selected as examples by the *Saturday Review*. The cockney, if ill-educated, says "I feel bad," when he means "I feel ill." I know that as well as the *Saturday Review*, being by birth a cockney myself. I have never heard a cockney say "I feel good" for "I feel well," or rather for "I am enjoying myself." But in any case both these expressions are rightly described as Americanisms by any one who, having lived in America, has had an opportunity of noticing how much more familiarly used they are in America than in England, and how frequently you hear them used by persons who are not ill-educated. The word "bullyrag" is really old English in origin, and now rather Irish than American in usage. Still it is so much more commonly heard in America than in the old country, that it is properly included among Americanisms. I omitted it in my first list (published when Knowledge was a weekly journal), and my attention was called to it by three or four correspondents, including one well-known American author. "Dicker," to bargain, is ancient and honourable, as English, says my all-knowing critic. Every one knows that. Lowell

* Schoolcraft, "Hiawatha Legends," p. 289. The idea of night coming down on the earth is referred to figuratively in a hymn used in the Catholic Church—

Dark night hath come down on us, mother, and we
Look out for thy shining sweet star of the sea.

Such references to natural phenomena are significant.

* Grant White's superior knowledge of the relative peculiarities of English and American English may be inferred, perhaps, from his essay, showing that forty years ago Englishmen *all* dropped their h's, and his attempt to prove this by the use of such expressions as "an hundred," "an hosier," "an hotel," in English writings. I venture to back my acquaintance with this particular subject against Grant White's, who was, indeed, but a shallow and pretentious writer, and naturally, therefore, arrogant and insolent.

pointed it out (quite unnecessarily) long ago. But the word is an Americanism now. It is never heard in England except as a provincialism. It does not appear in any English dictionary, from old Walker to the modern and most excellent Annandale. On the other hand, it is quite commonly used in America; it appears in many American books, and it is given both by Webster and by Worcester, the two chief American lexicographers.

To "elect," in the sense of choosing one of two alternatives, is only "a literary vulgarism," not an Americanism at all, says my critic, who ought to be a judge of vulgarisms. So the expression "at it again" is a vulgarism, yet, as it is a vulgarism very commonly heard among clowns, we call it clownish. In a similar way, "elect," in the sense referred to, is much more commonly used in America than in England, and is properly called an Americanism.

Having indulged in this puerility, which would exclude ninety-nine out of a hundred of the most characteristically American expressions, my critic takes me to task for what he pretends to regard as mistakes. After "bullyragging" me as he has, he ought to find "dozens" (his own word) of bad blunders, and let us see how many he does find.

He says, I "fail miserably" in defining Chowder as a dish consisting "of fish, pork, onions, and biscuit"—"a most inaccurate definition of a most delicious dish." (I remark the womanish "most delicious.") Considering that Grose, Bartlett, Webster, and Worcester agree in defining "Chowder" as I have done, I venture to consider the definition probably sufficient. Possibly my critic may have tasted some less usual form of Chowder. But if I had said that Chowder is a dish in which "birds, squirrels, crayfish, potatoes, onions, pork, fish, biscuits, and a number of other articles of food are cooked together in a camp-kettle," I should have been describing a special Chowder as distinguished from ordinary Chowder—substituting my special experience for the more generalised experience represented in the definition given by Webster and Worcester. As for the derivation of "Chowder" from a Canadian corruption of *chaudière* (a matter which could only interest a Canadian), my "Notes on Americanisms" have little to do with such points. I observe this second Canadian touch.

He next takes the word "Bonanza." The word is applied in California to the discovery of a rich vein of gold or silver; and the name came into general use in that sense soon after the discovery of the great silver mines on the Comstock lode. So much the *Saturday Review*, borrowing from the despised Bartlett, is careful to explain; and so much I might easily have stated without borrowing—though, had I been ignorant of the facts, there was Bartlett before me to set me right. I omitted it, however, for two excellent reasons. First, I supposed every one knew it;* and secondly, the use of the familiar word in that sense is not an Americanism—it belongs to the slang of miners and stock speculators. The word "Bonanza" is only an Americanism in the sense in which I defined it. The *Saturday Reviewer* says the point is completely missed by me; it is really missed by himself. If he had lived, as I have, where the word "Bonanza" has come to be used as a true Americanism, he would know that it has just the significance I have given to it. But his acquaintance with Americanisms is evidently local—not to say provincial—and far behind date. Down east, or in Canada, they might make such a mistake; not where I live—in the very heart of the United States. I observe this blunder, however, attentively.

With the most obvious desire to smash and pulverise my "Americanisms," these are positively all the words on which my weak, though spiteful, critic can comment unfavourably. He notes only one omission—"buzz saw" for circular saw. Friendly correspondents have earned my thanks by noting at least a dozen, which will hereafter be added in a short list alphabetically arranged. I have no doubt many more will be noted. My critic's failure to show worse faults involves the highest commendation he could pay me.

And now let me touch on the question whether, as my critic asserts, I am going entirely out of my way in dealing with Americanisms. I wonder whether every student of science who has dealt with subjects seemingly outside his province, could indicate quite such special study of them as I have given to this one. Our contributor, Mr. Grant Allen, for example, whose graceful and generally sound essays on a singularly wide range of scientific subjects we have all read with pleasure—could he, I wonder, give an equally good *raison d'être* for his novels* as I am about to give for my "Notes on Americanisms"?

The readers of Knowledge know that in commencing these papers I did not *claim* any special knowledge of the subject, only great interest in it. I even stated that I should take Bartlett for my guide, supposing that I should find him trustworthy, though in reality I merely proposed to use his book as giving a convenient alphabetical arrangement, by running along which I should probably get in all the words requiring to be dealt with. If, however, I had wished to indicate exceptional study of the subject, I might have made out a rather strong case. To say that my critic has not had a tithe of my opportunities is to say nothing; for evidently he has only picked up a few words from the pretentious pages of Grant White, which he uses after the manner advised by Sam Slick for deceiving the inexperienced. But I might ask fairly enough, if there are twenty men living, if there are ten, if there are *two*, who can match my own opportunities for obtaining that kind of knowledge about Americanisms to which alone I (*and only now for the first time*) lay claim.

I have been from my boyhood upwards a loving reader and student of old English writers from the time of Gower and Chaucer to the pre-Shakespearean dramatists. I have read with equal zeal the writings of those who, from the time of Bacon, Hooker, Spenser, and Shakespeare, to the end of the eighteenth century, give us, on the whole, the best means of forming an idea of the English which the first settlers in America took with them. Besides this, and very wide reading of modern English literature, I have taken especial interest in all matters of dialect and provincialisms, including the English of Scotland and Ireland. It so chances that I have resided in more parts of the British Isles than most Englishmen know much about. Born in London (in the house where Carlyle died), I heard a good deal of the London dialect in early boyhood. I lived many years in Kent, and have been a householder in Ayr, Edinburgh, Blackrock (Dublin), Falmouth, Plymouth, St. Helier's (Jersey), Brighton, Kew, Woolwich, and elsewhere, residing as a visitor in many other places, and travelling, during my lecture tours, to almost every nook and corner of the British Isles, with abundant opportunities for hearing and learning about local dialects. So much I note, because no one is com-

* The "Big Bonanza" must have been acted before three millions of folk, and discussed in papers reaching twenty millions more. No one needs to be told the original meaning of this Spanish word, or about its first application to mines.

* I see no reason why a science writer should not write a novel, if he can write a good one, or even one to sell. Why, for instance, should the skill with which Mr. Grant Allen makes science "very popular" in the *Cornhill*—keeping her even on the broad grin—cause us to distrust the "delightful self-satisfaction" with which he scatters "most delicious kisses" broadcast through "For Maimie's Sake"?

petent to discuss Americanisms who has not made rather exceptional acquaintance with the literature of the old country and the dialects of its various parts.

All this, however, would be useless without an exceptional acquaintance with America. On this point I remark, in the first place, that I have read, I think, everything written by Americans which may be regarded as having taken a place in literature. Next as to my personal acquaintance with America and Americans:—I first reached America in October 1873, and stayed there seven months, giving 104 lectures and visiting most of the chief cities of the Eastern and Northern States, but getting no further west than Missouri. I had all the time exceptional opportunities for hearing Americans talking—from continuous conversations (occasionally even more than I desired) on railway journeys, to most agreeable converse at the clubs; at receptions, at entertainments, in special gatherings for discussion, on the cars, in river steamboats, and under abundant varying conditions, I heard and noted Americanisms by the thousand in all classes of society. From October 1875 to May 1876, I had similar opportunities, travelling at this visit as far west as Nebraska and as far south as Kentucky, and giving 146 lectures. From October 1876 to May 1880 I gave 138 lectures in America, going over to the extreme west, and closing the tour with a fortnight in San Francisco. Returning from Australasia in January 1881, I gave more lectures, raising my total almost exactly to 500, chiefly in the west, but I ranged over to New York (State), New England, and Canada, closing the course at Greencastle, Ind., on April 30. Thence I went to Missouri, where on May 3 I married a Missourian lady, daughter of a Virginian father and a Kentuckian mother, and related to many of the principal Southern families. Of the five-and-a-half years which have passed since then, about two-and-a-half years have been spent in America, chiefly in my own house at St. Joseph, Mo., on the bank of the Missouri—amidst a population in which almost every variety of American dialect is found, from the true Yankee to the purest Southern, the strongest Western, and the quaintest negro dialect. At my own table we sat down day after day twenty-two in number, four or five English, the rest Virginian, Kentuckian, Missourian, &c., most of us having travelled widely so as to know a good deal about other places than our respective homes. We were waited on by coloured women, two of whom had been slaves in the household of my wife's uncle. If the opportunities I then had for learning to distinguish the various colloquialisms which I deal with as Americanisms have been often matched, I shall hear with interest of the circumstances under which this has happened. But even this is not quite all. From August 1884 to May 1885, I was on a lecture journey again, accompanied by my American wife, and by my brother-in-law (the last, by the way, had had actual experience during many years of the mining life which my critic knows only from the dictionary definition of "Bonanza"). In this journey I lectured over a tract extending from Chicago to Houlton, Maine (extreme north-east), thence along New England, New York, and Pennsylvania, through Virginia, the Carolinas, Georgia, Alabama, Louisiana, Texas, so round the Indian territory and Kansas to my home in St. Joseph, Mo. During this journey I gave about 150 lectures, resided many days as a guest in the homes of my wife's relatives in Washington and Charleston, stayed at many of the most important cities of the South—four days in Richmond, Va., three in Wilmington, N.C., a week in Columbia, S.C., another in Mobile, Ala., three weeks in New Orleans, a week in Galveston (Texas), &c., &c., &c.,—and I had abundant opportunities not only for hearing Americanisms of all sorts, shapes, and sizes, but for discussing them with those who knew all about them, and appreciated my interest in the subject. I should have been a dullard had I not become exceptionally conversant with the Americanisms of the regions then visited. My critic may have been born in America, but assuredly he has never had one-hundredth part of my opportunities of taking and making "Notes on Americanisms."

In 1881, when I wrote my essay on "English and American English," I considered that few had had better opportunities than I to become conversant with the subject; but certainly among the few must be counted myself now as compared with myself in 1881. I may add that while I have a good memory for matters in which I am interested, I believe I am observant (in *such* matters) beyond the average.*

My "Notes on Americanisms," though thus the fruit of a most exceptional if not (as I think) unique experience, are in no sense ambitious. I leave it to my critic to talk "with delightful self-satisfaction" about "Political Americanisms" and Colonel Norton's glossary thereof, regarding political Americanisms as beneath contempt. (It will be noticed that I have diligently skipped nearly all of them thus far, in Bartlett's Dictionary.) I do not undertake to exhaust even the colloquial Americanisms, which are my chief, almost my only aim. I can, however, tell my critic what a "Horse Fiddle" is—which he puts as a test question—as understood out here in Missouri, where I am writing.

Charged with undertaking to write on a subject which I have not studied at all, I think I have succeeded in showing that it is a subject about which I can claim to know much more than most men, because of the altogether exceptional opportunities I have had for studying it. I certainly know much more about it than my critic. I might almost be tempted to say with dear old Reade, in wrath at the "anonymuncules of the press" (in the same half-jesting tone), "It is a subject about which I know *everything*, my critic *nothing*."

"SATURDAY REVIEW" BLUNDERS.

THE *Saturday Reviewer*, who professes to know so much about Americanisms, has brought out an article on the subject simply crowded with blunders.

My critic's first article—a month late as a criticism of the July number—appeared a week after the August number. Yet this second essay opens with the discovery that in Knowledge for August there are no Americanisms!

Observe,—five days before the proofs of the first article were corrected, the August number, which the writer of that article had not seen, was on every railway stall in England. Obviously both articles were written at a distance, and the later one was retouched, but not quite deftly enough, by a friend at headquarters. (The lateness of my own reply, writing as I do in Missouri, will be understood, as also the generosity of the critic who waited till he knew I had left England before opening an attack on a series begun four months before.)

This same opening sentence speaks of my "glossary of

* I noted such more delicate Americanisms as the "Why, certainly," of the East, the "I know it," where we would say in England simply "I know," the "won't you?" where we would say, "will you?" and so forth, in that earlier paper—years, by the way, before "the Colonel" had suggested the erroneous idea that, "Why, certainly," is a novelty, and an obtrusive one at that—as Americans say. So far as shown, previous visitors had touched only on the more glaring Americanisms: certainly Dickens had.

Americanisms" as "amusingly and amazingly inaccurate," oblivious of the fact that in the first article, intended to convey this impression, my critic could point out only one doubtful omission, and two supposed inaccuracies—really his own. As there are upwards of two hundred words in the first two sections out of four (I have counted no further) which the critic examined with his most unfriendly eye, I maintain that he has really proved the notes to be singularly accurate, so far at least as his opinion is concerned. Two bad potatoes in a plate may have a bad effect, but two only in four sacksful would have a very different significance. And, as I have shown, even the two words "Chowder" and "Bonanza" are correctly dealt with by me—the only blunders about them being my critic's.

Thirdly, my critic ventures to correct me for using the word "Americanisms" in its wider sense, instead of the absurdly narrow sense he prefers. I might limit my Notes (observe, by the way, how modest the word and how remote from the "glossary" he attributes to me) to "Americanisms made in America by Americans" and "foreign words left by former Spanish, French, and Dutch colonists"; but, on the one hand, I could not justify such a limitation, and, on the other, no one would take any interest in so paltry a collection as would have resulted.

And now for my critic's special blunders, some of which are amusing and amazing indeed.

1. Horse-fiddle. This is no more an Americanism than the "charivari" itself. For an English illustration of a noisy serenade, see Hogarth's "Idle and Industrious Apprentices," showing indeed that the custom was not limited of old times in England to purposes of annoyance. The use of the word "horse," as in "horse-laugh," to imply something loud and coarse, is not American at all. An English rough who made a noise-producing instrument, scraped bow-wise, would be sure to call it a horse-fiddle. But even as to the American use of the word and of the thing, my critic blunders. He describes the horse-fiddle as known only in New England, whereas it is known in every State of the north, the east, and the west. He describes only one form of it, whereas there are half a dozen at least, to my knowledge. He describes only one use of it, as the bass instrument in a "charivari," whereas it is often used as a convenient calling instrument. In Ohio, for instance, a horse-fiddle is (or was quite recently) used to call men and dogs together for the American form (utterly unlike the English) of a fox-hunt. The name is also applied to a coarse kind of Æolian harp, in which strings dipped in coal-oil are stretched across a suitable wooden case, a gruesome noise resulting when the instrument is placed where a strong wind can work upon it.

2. Hauled Mealer. My critic employs much space to explain that a "mealer" is one who takes meals, and that "hauled" means "conveyed in a vehicle." The blunder here consists in the amazing absurdity of supposing that any one wants to know about such Americanisms (save the mark !) as these. A member of my household calls a carriage dog a "plum-pudding dog." Shall I put that down as Missourian American? Another—very young—has invented the appropriate call, "Look at it ! look at it !" when a masher, a white-chokered coloured man, or any other preposterous person appears. Shall I call the quaint cry an Americanism? I know a case where the word "death" is always used for "a common lot," as applied to a "crowd" (as Americans say). Shall that go down, too?

3. Time. My critic quotes Mr. Saintsbury as saying that many may regard the expression, "a glorious time of it," as an Americanism, whereas it is good old English. But it is not even old in the sense of being out of date. The expression is constantly used in every part of England. (In passing, though, I note that "time" is no longer used in England when its meaning might be understood as in Nicholas Nickleby's well-known retort; whereas in America there is no such objection to the use of the word, the meaning suggested by Mr. Nickleby not having come into use.)

4. Deck, for pack of cards. My critic carefully insinuates the untruth that I have here "set down as of American origin a word which is in 'Shakespeare.'" I referred to the *play*, *act*, and *scene* where Shakespeare uses the word ! His blunder here consists in the feebleness of his *suggestio falsi*.

5. Peart. There is a similarly unwise untruth here. Bartlett mentions rightly enough that this word is "provincial in parts of England" (I have repeatedly heard it myself in Devonshire and Cornwall), and even quotes a passage from a letter of Sir Philip Sidney's. (I think Bartlett is mistaken in regarding "peart" as a corrupt pronunciation of "pert"; the fact really is that our "pert," pronounced "purt," is a corrupt pronunciation of "pert," properly pronounced originally like the French word *perte*. "Peert" and "peart," as now sounded, are corruptions of the "pearte" of Sidney's time, when "*ea*" and other words always represented the sound we retain now only in a few words so spelled—as, for example, "great.") "Pert" was derived from the old French *apert*, still remaining in *malapert*.

6. Reckon. "I reckon" for "I think," still used as a provincialism in England. Therefore our *Saturday Reviewer* would remove this from among Americanisms. The use of "reckon" in this way is only local in America. It belongs to the south, and rather specially to Kentucky. Albeit, neither consideration can properly exclude it from among Americanisms. It belongs, indeed, to the only class of Americanisms really interesting to study, for the evidence they give about old English words and phrases. This again (for a correction on Bartlett) is, as an untruth, emphatically feeble. Bartlett tells all about the provincial use of the word. In fact, my critic's second paper, by causing me to look somewhat carefully into Bartlett's pages, has greatly raised my respect for his work. He goes wrong about many English provincialisms not found in books, but where there is documentary evidence he has nearly always lighted upon it.

Like for "as." Another weak falsehood here also. Bartlett touches on the English use of this expression. The *Saturday Reviewer* puts its English use as out-of-the-way knowledge. I have heard it myself repeatedly, especially in Lancashire and Yorkshire, where educated people use it freely. It occurs also commonly enough in books. I differ altogether from Bartlett in regarding this as an Americanism at all, for it is at least as often to be noticed in England as in America.

Switch. Noun and verb. Here, following Bartlett, the *Saturday Reviewer* goes grievously wrong. Bartlett says the word is coming into use in England, but describes it as the American for the English "shunt." As a matter of fact, "switch" has been in use in railway-English since railways, and long before locomotives were invented. There is a real difference, however, in England between "switching" and "shunting" a train, which is not generally recognised. A train sent off to another line of rails is said to be "switched off," but a train is properly said to be "shunted" only when it has been switched off for the purpose of allowing another train to pass. The term "switch" is general, "shunt" particular. "Switch" is related to "swing," and "shunt" to "shun."

Molly Cotton-tail, for a rabbit. The *Saturday Review* critic is for a wonder nearly right as regards this word : it seems not to be in his nature to be quite right.

A rabbit is called a "Molly Cotton-tail" in Virginia; but not in Virginia only. The word is used in both the Carolinas and in Georgia. It has now spread westward, and I have heard it used in Missouri.

Gum. This word supplies the absurdest of my critic's mistakes, except only the next, which I have preserved as a *bonne bouche*. "Gum is," he says, "the Philadelphian's extension of the word 'gum' to include all manufactures of india-rubber, and especially overshoes." *Indeed!* Bartlett tells us all about "gums" for overshoes; and the very story which my critic gives in illustration, as a new one, was told me at the Century Club, New York, in December 1873 (ah! pleasant evenings at the Century, if I ought not rather to say pleasant nights—veritable *noctes Ambrosianæ*); and then it was told as an old one, and not by any means Philadelphian, or even Pennsylvanian, but American, *pur sang*. The story is good, however. A man arriving on a muddy night at the house of a friend (an untravelled city man of New York), was asked where his wife was. He replied, "She's wiping her gums on the mat." I heard the word "gum" thus used only a day or two since by an American step-daughter of mine, here in Missouri. As a matter of curiosity, I have asked my father-in-law what he knows of the use of this word in "old Virginny." He says that half a century ago, at least, everything made of india-rubber was called a "gum" there, without any other name except when doubt might arise. Thus a lady, when speaking of fastening a veil, would speak of the elastic as simply the "gum," otherwise as the "gum elastic"; a rubber ball would be a "gum ball," but a boy at ball-play would say, "Throw the 'gum,'" or "Catch the 'gum.'" The word "gum" used alone would generally mean the same as "rubber," that is, an india-rubber overshoe—our golosh. Everyone here in Missouri, and I believe throughout the States, would so understand "gum" and "gums." The word belongs about as much to Philadelphia as "Bantam" to Bradford. As to novelty, the expression probably is quite a new one—to my critic.

I may note in this connection (as Americans say, oftener than English folk) that if white men cut down words—as in this case, from "india-rubber overshoes" to "rubbers" or to "gums"—coloured folk are just as apt to reverse the process. Thus gum, and rubber, and india-rubber are combined into the odd word *Gunjer-rubber!* Elastic becomes *rubber-lastic*. We find even the monstrosities *Gunjerlastic* and *Gunjer-rubber-lastic!*

Use. My careful critic has discovered an example of recent and temporary American slang in the case of this word. "Just now," he sagely writes, "a New Yorker expressing his disapproval of a person or a thing, will tell you that 'he has no use for it.'" If the *Saturday Reviewer* had written fifty columns he could not more thoroughly have exposed his ignorance. He had written impudently enough that he had been moved to explain certain terms "in the hope that Mr. Proctor may be encouraged to learn something about the subject before he presumes to teach." *Mutato nomine de te*, my critic, *Fabula narratur*. Will English readers believe that this expression, which the ignorant *Saturday Reviewer* imagines to be "just now" coming into use "in New York," has been in use certainly half a century in nearly every part of the United States? It was one of the first expressions which attracted my attention in 1873 in New York and Boston; my wife, a Missourian by birth, recalls it from her earliest childhood; my father-in-law remembers it as familiarly in use when he was a child in Virginia; and a score of persons to whom I have related this excellent *Saturday Review* joke, attest the use of the expression throughout America—some of them referring it back *over sixty years!*

An associated use of the word may be mentioned as rather quaint; it is probably quite as old as the other, though my own recognition of it does not date back more than a dozen years. An American will speak of a person as too absurd, or too ordinary, or too homely *for any use!* For example, I should be correctly applying this Americanism in saying, "My critic is too ignorant, or too spiteful, 'for any use.'"

I may add, in conclusion, that although the *Saturday Reviewer* chances—strangely enough—to repeat a truth when he says that Charles Reade and Anthony Trollope failed lamentably with their American talk, he is altogether mistaken—naturally enough—in comparing the mistake with that of one who should mix Cockney, Yorkshire, Irish, and Scotch, and use it for English. American provincialisms are nothing like so marked as this comparison would suggest: moreover, Americans travel about so much, and many of them are so quick at appropriating oddities of expression, that even the curiously mixed talk of Joshua Fullalove, and the less obtrusively bad American of the senator, are not really so bad as they seem. They are bad enough though. Yet this does not much matter, any more than the very bad Irish of Thackeray's Costigan affects our enjoyment of "Pendennis." As an example of utterly incorrect dialect—equally harmless, however—I might mention Mr. Grant Allen's West Indian negro talk, which is an odd mixture of true West Indian dialect and such expressions as are met with among the coloured people of the States.

ARE SUN-SPOTS HOLLOWS?

THE evidence adduced by Dr. Wilson and subsequently confirmed by Sir W. Herschel, to show that sun-spots are saucer-shaped or funnel-shaped depressions, has been seriously questioned by many careful observers of the sun. The latest to express doubts on the subject is that zealous sun-observer (I had almost said sun-worshipper) the Rev. F. Howlett, some of whose admirable pictures of sun-spots we were allowed three years or so ago to reproduce in Knowledge. He writes, in the somewhat sepulchral pages of the Astronomical Society's "Monthly Notices," as follows:—

"I am desirous of placing on record some definite statements and measurements in connection with the appearance of certain symmetrically-shaped solar spots, both when near the centre and also when close to the limb of the sun. It will be found that these measurements entirely militate against the commonly received opinion that the spots are to any such extent sunk in the solar surface as to produce always those effects of perspective foreshortening of the inner side of the penumbra (when near the limb) which have been described in various works on astronomy.

"In my contention that by no means the majority of spots present that funnel-like appearance attributed to them by the Wilson hypothesis, I am sufficiently borne out both by Father Perry and Mr. Ranyard. The former, after paying especial attention, at my request, to this point in connection with a large and unusually symmetrical spot which was close to the western limb on the afternoon of April 12 of this present year, wrote me thus:—'The question of the foreshortening was specially attended to, and the observation showed a very slight excess of foreshortening on the side of the penumbra nearest the sun's centre, but certainly not enough to give any support to Wilson's theory.' Mr. Ranyard, again, in a letter of the 7th inst., reports:—

'I had a good look at your spot on the morning of Wednesday, June 2, and I again had a search for it on the morning of June 4' (when, I may observe, it had quite passed off the limb). 'I quite agree with you,' he says, 'that there was no appreciable difference in the breadth of the penumbra on the preceding and following sides of the nucleus' (umbra is here meant) 'when I observed it on the morning of Wednesday, June 2. I was observing it between 9h. 20m. and 10h. A.M., and I thought that the penumbra was a little *darker* on the preceding than on the following side, but not very noticeably so. There was no band of increased darkness such as would have been produced by a column of absorbing matter rising vertically above the nucleus. I quite agree with you that the phenomena observed did not tend to support Wilson's hypothesis.'

"With respect to this last spot, Father Perry's observations do not confirm my own to the same extent, apparently, as was the case in connection with the spot γ of April last, though it is on that of June 2 that I would rely, if possible, more firmly than on the rest. Together with some small but beautifully executed copies of the sketches of spots made recently at Stonyhurst, Father Perry wrote as follows :—'You will notice that near the edge there appears to be a slight confirmation of Wilson's theory at both limbs of the sun.' And he adds, 'In some of our drawings of solar spots this is much more marked ; but these probably are different classes of spots, and all certainly do not behave al ke.'

"But now as to actual *measurements* of what I would term the crucial spots γ of April 12, and λ of June 2.

"I first noticed γ on April 2, at 7h. 30m. A.M., when it was about 2′ 48″ from the eastern limb, and perceiving that the umbra was nicely central, and the whole spot neatly oval, I resolved to keep the spot under observation, with the view of testing the hypothesis in question. It was then about 50″ in length from north to south, and, as then, foreshortened on the sphere, about 40″ in breadth from east to west. On April 6 the size of the spot was somewhat diminished, but its neatness and suitability for testing the hypothesis was still more apparent, for a more perfectly central umbra or symmetrical penumbra could not be wished for. The spot 10h. 20m. A.M. that day was not far from the centre of the disc, and subtended about 45″ in length and the same in breadth.* When at length, on April 12, the spot had arrived very near to the western limb, I made the following notes :—At 4h. 20m. γ was only about 10″ from the western edge of the sun, and subtended not more than 10″ in breadth. The umbra still appeared quite central, with a width of not more than 2″. Each side of the penumbra measured also about 2″ in breadth, or possibly the 'preceding,' or outer, side, 2″, and the 'following' 1″·8, but of this I could not be quite certain.

"I may observe also, in passing, that on May 9 a spot lettered ι, when about 18″ only from the western limb, and measuring 40″ in length and 8″ in breadth, presented a perfectly central umbra 3″ in width ; here again militating against Dr. Wilson's hypothesis.

"But now for the spot λ of June 2, 1886. This was also a remarkably symmetrical one, of a large size, and specially adapted to the investigation in hand. On June 1 the spot was, at 5h. 30m. P.M., just one minute from the western limb, yet there was not the slightest appearance of any foreshortening of the *inner* side of the penumbra. In fact, if there was a difference, the advantage was by about 1″ or so on the *inner* side. The spot now subtended about 45″ in length, by about 17″ in breadth.

* It is most unfortunate that Mr. Howlett did not measure, or at any rate does not mention, the breadth of the penumbra—that is, in effect, the size of the umbra.

"On June 2 (the day on which I had invited Mr. Ranyard, and also again Mr. Perry, to specially watch for Wilson's phenomenon) I made these notes :—At 7h. 50m. A.M. the outer border of the penumbra of the spot λ was just 20″ from the western limb. The whole spot subtended 45″ in length of heliographical latitude, but so foreshortened in directions of longitude as to subtend not more than 10″ in width.

"The *umbra* was as nearly as possible central, and having an apparent width of 3″. Both the preceding and following sides of the penumbra were of the same width, viz. 3″, though if there were a difference, the 'following,' or *inner*, side was the wider of the two, by perhaps 0″·5. There was at least a *sensible* difference (though exceedingly small, truly) in the opinion both of myself and a perfectly impartial fellow-observer, who, in fact, did not know what was expected one way or the other.

"I regret that there should have been any divergence of opinion between Father Perry on the one side and Mr. Ranyard and myself on the other, though that divergence is evidently extremely slight. What we require, however, in such investigations are actual measurements by micrometrical appliances."

In my treatise on the "Sun" observations of a kindred nature by several observers are mentioned, the earliest probably being Sir W. Herschel's observation of a spot in 1783, of which he remarks :—"I observed that, contrary to what usually happens, the margin of that side of the spot which was farthest from the limb was the broadest." Nothing, perhaps, can be regarded as much better established, or by a more widely ranging series of observations, than the fact that sun-spots do not systematically, even if regular in outline, present the signs of a funnel-shaped form which Dr. Wilson recognised in 1769, and the elder Herschel in 1779. The latest statements, before Mr. Howlett's, on this point are those addressed by Professor Spörer, of Munich, to an assembly of astronomers at Geneva in August 1885. He there, "in a copious *résumé* of his labours in connection with the solar spots" (I quote from Mr. Howlett's paper), "denies that the spots possess the character of funnels (*tonnoirs*), which is attributed to them in the greater number of works on elementary astronomy. The appearances which attend the disappearance of spots on the sun's western limb cannot, he affirms, be explained by such a theory. 'When a spot,' he says, 'is very shortly about to disappear, by virtue of the sun's rotation on his axis, the two *lateral* borders of the penumbra vanish from sight, whilst the nucleus [umbra] remains visible, together with the fragments of the surroundings (*pourtour*) to the north and south ; the whole phenomena,' he says, 'presenting the appearance of a veiled brightness (*éclat voilé*) to such a degree that one might easily confound the nucleus [umbra] itself with its surroundings,' and of which typical and striking instances may be seen in vol. ii., sheet 99, and still more sheet 108, of my drawings. He seeks to explain this appearance by a heated facular border surrounding the spot, and causing an ascending current of extremely heated gas, through which it is with the greater difficulty that the spot is discerned, the nearer it is to the limb."

Mr. Howlett mentions, among possible solutions of the difficulty, the possibility that the refractive action of the sun's atmosphere, by which somewhat more than half his sphere should be visible to us, may be in question. He overlooks here the circumstance that small well-defined spots have been observed to appear on the eastern limb, and disappear at the western, at epochs by no means agreeing with the supposition of a refractive action outside the photosphere sufficient to show appreciably more than half the solar globe. Nor could prominences be flattened or levelled

as he suggests, at least in recognisable degree. In fact, their appearance and changes of appearance suffice entirely to negative this view.

I have long seen reason to believe that the explanation of the peculiarities of appearance observed when a spot is near the sun's edge (or "limb," as astronomers call it, comparing it not very reasonably with the limb of a sextant or quadrant) is to be found in the refractive action of the vapours occupying the depression which the sun-spot really forms beneath the level of the photosphere.

In the following figures (from my "Sun") I illustrate what is observed, as well as what ought to be observed, under different assumptions:—Fig. 1 shows in the upper

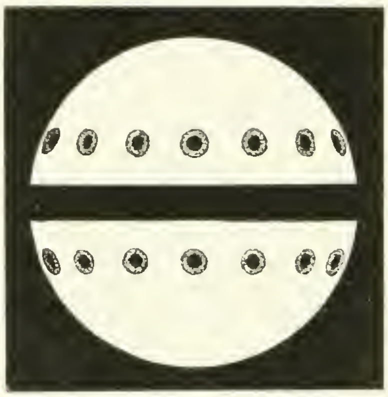


Fig. 1.—Spots on the Sun—Actual and Theoretical Changes.

row the changes recognised by Dr. Wilson; in the lower row the features which would be seen if the spots were surface stains with umbra and penumbra symmetrical.

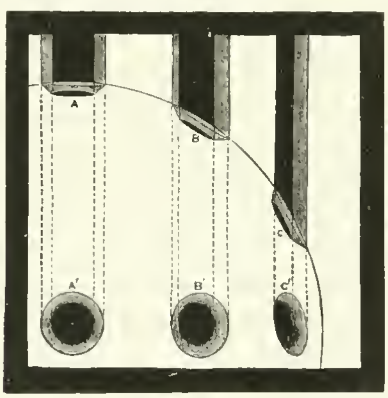


Fig. 2.—Wilson's Explanation of Sun-Spot Changes.

Fig. 2 illustrates the explanation of Wilson's observations commonly advanced, and first suggested by himself. Fig. 3 illustrates the feasibility, so far as Wilson's observations are concerned, of Kirchhoff's explanation, according to which spots are produced by the absorptive action of clouds floating above the surface of the sun.

For my own part I cannot understand how any one who has observed the general phenomena of sun-spots, and especially the peculiarities of appearance they present when near the middle of the disc, can doubt for a moment that they are, or rather indicate, depressions below the surface. There are at least a dozen better reasons for so regarding them in the phenomena of sun-spots, as seen near the middle of the disc, than in the doubtful effects of foreshortening of spots near the disc's edge. Moreover, the phenomena observed under the former and more favourable conditions would suffice of themselves to render a very fair account of the peculiarities observed under the latter conditions, manifestly unfavourable for deducing exact information.

I regard the problem to be explained as in reality this:—

Since the sun-spots manifestly show themselves to be depressions, when observed near the middle of the disc, why do they not always present the appearance due to that form when near the edge? Why in particular should the penumbra on *both* sides of a spot's shortest diameter when

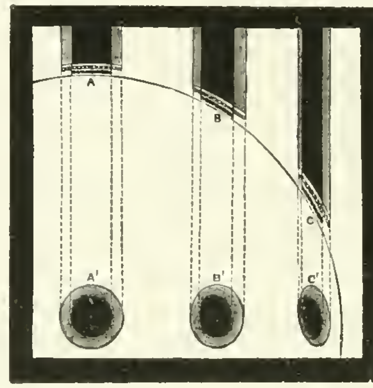


Fig. 3.—Kirchhoff's Explanation of Sun-Spot Changes.

near the edge be (or *seem*) often much narrower than we should expect it to be?

When we take into account the refractive action of the vapours within the saucer-shaped depression of a symmetrical spot, we find a sufficient explanation.

Suppose, for instance, that we have in fig. 4 a rough representation of the section of a spot, when, as yet, the action, whatever it may be (eruptive in my opinion), to which the opening is due, is in its early stage, so that the regularity of the spot is as yet unbroken. The figure shows between SPP' S' and a UU' b the streams of ascending glowing vapour, partly condensed into cloud form, which, vertical where there is little disturbance, form the so-called rice grains. We see them near the spot-opening thrust sideways, so as to be packed near their tops into the great facular masses seen around a spot. The expansive action of the vapour within the spot region, carried as it has

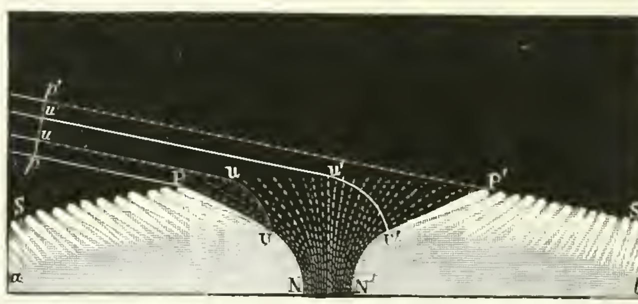


Fig. 4.

been from regions of greater pressure deep down below, leads to a cooling (relative only, of course), by which the vapours acquire the absorptive power indicated by the darkening of the spot region. We see also why, looking vertically down into the spot, the central part appears the darkest, for though in looking at the nucleus we are looking towards NN', where the vapour is hotter than at UU', and in looking at the umbra we are looking towards UU', where the vapour is hotter than at PP', which marks the outer limits of the penumbra, yet we have a greater range of absorptive vapours in the first case than in the second, and in the second case than in the third. Probably, also,

the region of vertical clouds of condensation, whose upper surface is the photosphere, while its lower surface marks the inside limit of the penumbra, is intrinsically brighter and hotter (because of the heat liberated in condensation) than the region of vaporous matter in which the clouds form, and above which they are suspended. Now the vaporous region NUPP′U′N′ must possess considerable refractive power, since it is dense enough to produce great absorption. Hence we are not only justified in expecting, but compelled to take into account a measurable deflection of the lines of sight by which the various parts of the interior of a spot are seen, when the spot is near the edge of the solar disc, and so viewed aslant.

Suppose now pP and p'P′ to be the lines of sight, not appreciably deflected, to the outer edges of the penumbra, P being the edge nearest the centre of the disc, P′ the edge nearest the limb. Not taking deflection into account, we see that the penumbral face P U would be absolutely invisible, while the face P′ U′ would occupy nearly the whole breadth, pp', of the range of view. But the lines of sight u U and u' U′, being similarly curved by refraction from U and U′ to U and U′ respectively, the penumbral face P U will manifestly be brought into view, while the penumbral face P′ U′ will be narrowed. And it is easy to understand that since spots vary much in size and depth, and also presumably in the constitution of their vaporous contents, the amount of deflective action will be correspondingly variable, and therefore the varying effects of foreshortening, from that observed by Wilson down to apparent absence of foreshortening, can be readily explained—or rather are obviously to be expected.

We can see, further, that when the lines of sight to the spot are still more aslant than as shown in fig. 4, the deflective action may just fail to show PU at all, while it will so narrow the opposite face P′U′ that this face will also be lost—especially as it is looked at through a much greater range of absorptive vapour. This last point must also be considered in dealing with estimates of the two sides of the penumbra of a spot near the edge; for the darkening of a penumbral streak may very easily be mistaken for narrowing; in fact, from the known laws of irradiation this deceptive effect may be expected. It would even affect photographs, for photographic irradiation is as real and almost as sensible as the irradiation affecting the ordinary vision of bright objects.

SOME PUZZLES.

(*Continued from p. 337.*)

Problem IV. *Let* ABA′B′ (*fig.* 1) *be an elliptical form,* P *the farm house. We have to divide this farm into three equal farms, each having a perimeter equal to that of the undivided farm, and each also in free communication with the farm-house.*

Through C, the centre of the ellipse, draw the diameter PCP′; and divide PCP′ into three equal parts in the points p and p'. On Pp, Pp', describe the half ellipses Pbp and Pbp', similar to the half ellipse PABP′, and similarly situated. On P′p' and P′p describe the half ellipses P′$b'p'$ and P′b′p, similar to the half ellipse P′A′B P, and similarly situated. Then the three spaces into which the ellipse is divided by these curved lines are equal to each other, have equal perimeters, and all obviously communicate with the farm P.

For the half ellipses on the left of PP′, taking them in order from P, have areas as 1, 4, 9, so that the portions of the farms on that side of PP′ have areas as 1, 3, 5. The corresponding portions on the other side of PP′ have areas as 5, 3, 1. Hence the farms have areas as $1+5$, $3+3$, and $5+1$, or as 6, 6, 6.

The portions of perimeters on the left side of PP′ are as 1, 2, 3; the corresponding portions on the right side of PP′

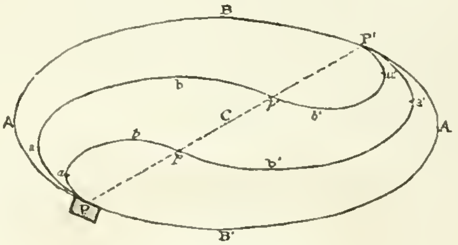


Fig. 1.

are as 3, 2, 1. Hence, taking the farms crossed by Pp, pp', and pP′ respectively, we see (on referring to the figure) that their perimeters are as—

(i) $1+2+3$, (ii) $2+1+1+2$, and (iii) $2+1+3$;

or as 6, 6, 6; while the perimeter of the original farm is as $3+3$, or also as 6.

It will be obvious that if any straight line be extended across the farms from P, and falling on the left side of PP′, it will be divided by the farm boundaries into three equal parts; and the like with any straight line extended across the farms from P′ and falling on the right side of PP′.

Problem V. *To draw six circles cutting each other in eight points at an angle of* 60°.

The method is shown in fig. 2. The path to the solution was suggested when the problem was presented as an exercise in stereographic projection.

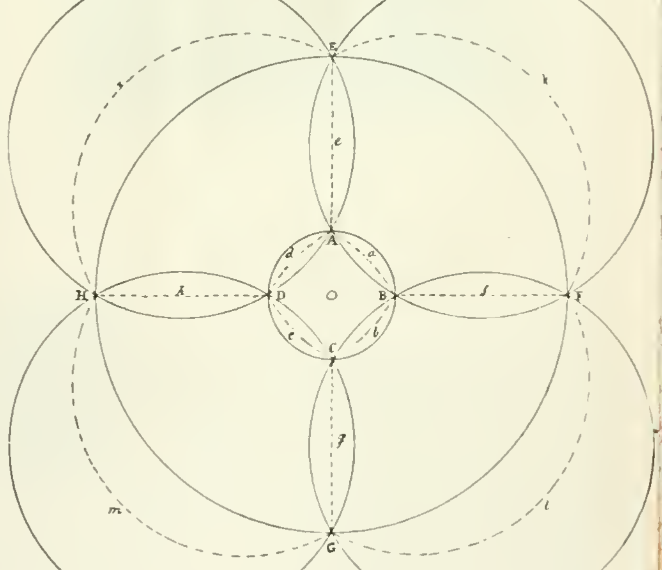


Fig. 2.

In fig. 2 the dotted lines represent stereographic projection of the six portions of a sphere corresponding to a circumscribing cube—the six maps, for instance, of the S.D.U.K. star atlas devised by De Morgan—the central point of one of them being the centre of projection. These are shown in dotted outline. The six circles are the stereo-

graphic projections of the circles circumscribing these six equal divisions of the sphere.

A little consideration will show that these circles intersect each other on the sphere, and therefore in the stereographic projection at angles of 60°. For the sides A*a*B, A*d*D, A*e*E meet at equal angles; each, therefore, 120°. Hence, A*a*B and A*d*D meet the circle ABCD at an angle of 30° (half of 180°—120°). They must in like manner (regarding them as representing sides of the spherical square EABF) meet the circle EABF at the same angle, 30°. Hence the circles ABCD and EABF cut each other at angles of 60°, and the like with all the other circles of the figure.

Note that the arcs A*a*B, G*m*H belong to one circle. The reason will be obvious to those familiar with the properties of the stereographic projection. For on the sphere the points A, G, lie at the extremities of a diameter, and B, H, at the extremities of another. So that the points ABGH necessarily lie on a great circle. Similarly with the arcs B*bc*, H*n*E, &c., &c.

PROBLEM VI. *To draw twelve circles cutting each other in twenty points at an angle of 60°.*

The method is shown in fig. 3. The explanation is similar to that of Problem V. In fig. 3 the dotted lines represent the stereographic projection of the twelve portions

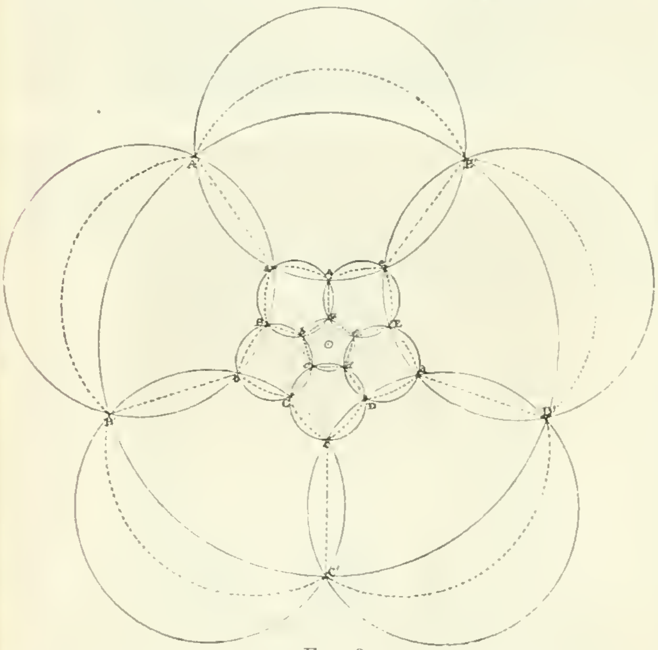


FIG. 3.

of a sphere corresponding to a circumscribing dodecahedron—the twelve maps, for instance, of my "Library Star Atlas" and "School Star Atlas," the central point of one face being the centre of projection. The twelve circles are the stereographic projections of the circles circumscribing these twelve equal divisions of the sphere. (In my atlas the twelve circles are the boundaries, so that the maps conveniently overlap.)

The dotted arcs *ab* and C'D' form part of the same circle, as do the arcs AB, Dd, &c., &c., &c. For the points *a*,C' are antipodal, as are *b*,D' and A,D, &c., &c., &c.

The problems for solution next month are these three :—

PROBLEM VII *To mark in a series of points on a card, by some simple geometrical construction, by joining which with straight lines a parabola may be pictured.*

PROBLEM VIII. *The same for an elliptic.*

PROBLEM IX. *The same for a hyperbola.*

(*To be continued.*)

THE SIXTY-FOUR SIXTY-FIVE PUZZLE.

IT appears that misprints in the description of my plan for improving the construction of the "64 65 square" puzzle rendered it unintelligible to many. The printers were not in fault, as this was the first occasion when any mathematical work has been done by them for KNOWLEDGE since the printing passed into their hands; and my plan of underlining single letters intended to be italic, seems to have been misunderstood in some cases as signifying small capitals.

I will now give a brief but better account of my method —which really makes the trick very much better than as usually presented :—

In fig. 1 we have the rectangle of 65 squares, 5 by 13. The diagonal B*b* cuts the fifth line *fa* in *h* above *e*, the

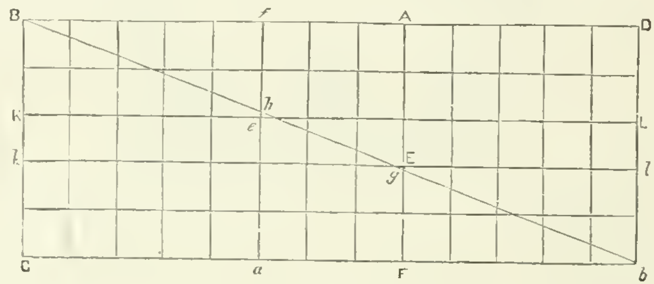


FIG. 1.

intersection of *fa* and KL; while it cuts AF in *g* below E, the intersection of FA and *kl*. In fitting the four pieces B*g*A, AD*bg*, *hab*, and BG*ah*, together, this defect may attract attention. If, instead, we divide up the square of 64 squares, a corresponding defect will arise which a keen eye will also readily detect.

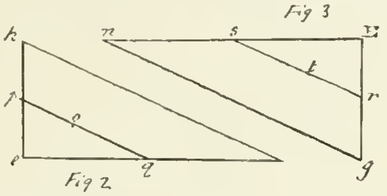
Let us see what the discrepancy really amounts to. Suppose the squares each 1 inch in the side. Then *fe* is 2 inches; and since $fh : Db :: Bf : BD$, we see that $fh = \frac{5}{13}$ of 5 inches. Thus $eh = 2$ in. $- \frac{25}{13}$ in. $= \frac{1}{13}$ inch $= Eg$.

To prevent a keen-eyed person from detecting, as he might, this 13th of an inch, halve it between the two arrangements. Instead of drawing B*b* as in one method (where the rectangle is cut up), or B*e* and *eb* as in the other (where the square is cut up), draw a line from B to a point midway between *h* and *e*, and from this same point carry on a line to *b*. In like manner, draw from *b* a straight line to a point midway between *g* and E, and from this same point carry on a line to B. Cut along these lines, by which you cut out a long parallelogram, having B*b* as a diagonal, and equal in area to half one of the 65 squares. This is thrown away. Thus practically, in presenting the problem this way, you put together areas equal to $64\frac{1}{2}$ squares, in such ways that they may be supposed either to make up 64 squares or 65 squares; whereas, on the usual plan, you either have to convince folk that 64 squares are 65, or that 65 squares are 64.

But on this plan, as on the other, you still fail to have true corners for the squares around *e* and E. Now this peculiarity of shape is more easily detected than the errors of length and area which affect the drawing. To get rid of it, the lines *fa* and KL must be altered. My plan for this, which makes the puzzle as nearly perfect as it can be, may best be illustrated as follows :—

Let *hem*, fig. 2, be an enlarged view of the small triangle which has *he* for a side in fig. 1. Let *p* be the middle point of *he*, and let *pq* be part of the cutting line to *b* on the plan described. Then *peq* is the triangle whose absence from the small square having *e* as its lower left-hand corner

is liable to attract attention. On pq take a point o nearer to p than to q, and instead of the lines KeL and fea, join this point o with the points f, a, K, and L. The error in the drawing will not be noticeable, and on fitting the four pieces together all the spaces around e will be four-cornered, and will seem to be squares. In like manner, with the other triangle having Eg as a side. Representing this on an enlarged scale, as in fig. 3 by Egn, and letting r be the middle point of Eg, and rs a part of the line from r to B



in fig. 1, we take t on rs as a point to be connected with A, F, k, and l.

The point o should divide pq, so that $po : oq :: fe$ to Ke (fig. 1), or :: 5 : 2. For then the deviations of the lines from f and K will be best distributed to escape attention. But f may be slightly shifted towards A, and K towards B, a towards b, and L towards D (still more slightly), to help the illusion. Corresponding remarks apply to the point t and lines from it.

When such precautions are taken the rectangle BDbC may be drawn very accurately, and all on a large scale, while the pieces may be left for thorough inspection and repeated adjustment without any chance of the trick being detected, even by measurement. Of course, even a lad with geometrical proclivities will detect the trick by reasoning.

MINUTE WRITING.

A FRIENDLY rivalry in minute writing sprang up recently among various correspondents of the *Newcastle Weekly Chronicle*. Someone had written the Lord's Prayer (with the Doxology, as in all cases mentioned later) within a space which a threepenny piece will cover. Then others wrote it smaller. At last, one wrote it within the space covered by the end of an ordinary pencil. On hearing of this, remembering that, when a lad, I had been able to write rather small, I tried my hand, and managed to get the Prayer into a space just over the half of that which the end of a lead pencil will cover. Not to be beaten, one of the small-writing company wrote the Prayer just within the half of a pencil end, though, as the editor of the *Weekly Chronicle* announced, not quite so distinctly as I had written it in a somewhat larger space.

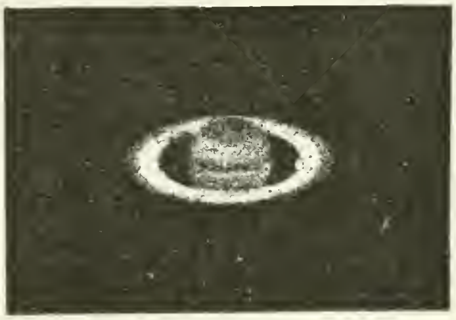
I then tried my hand again, having noticed that at each fresh trial I seemed to recover more of the skill I had formerly had in such small work. The result is thus described by my friend, the editor of the *Newcastle Weekly Chronicle*, who has been a sort of umpire or referee in this minute contest. (I trust no reader of KNOWLEDGE, after reading what follows, will assert that I have been making little of the Lord's Prayer.)

"Mr. Proctor, who is on a visit to Missouri, United States, has sent me three other specimens of his skill in microscopic writing. One of them is the Lord's Prayer written in less than a half-ring marked by a penholder smaller than an ordinary pencil-ring. Another is the same prayer occupying a space slightly over the half-ring. A few touches of the pen have given the latter specimen the appearance of the sun rising out of the sea. The third specimen is in some respects the most striking and curious of the three. It is the Lord's Prayer written three times over on three straight lines a shade over two and a half inches long. The writing in this case is so straight and minute that the three lines look to the naked eye like three ruled lines. And yet, when placed under a magnifying glass, every word is seen to be perfectly distinct. Mr. Proctor's feats are perhaps all the more remarkable since they were performed under trying circumstances—when he was, as he states, 'roasting at St. Joseph with the thermometer at 107° in the shade.'"

I expect some of the others will get ahead of this, and, if so, I shall try yet again, in more favourable weather than we have yet had in St. Joseph for work of this sort.

PHOTOGRAPH OF SATURN.

THE accompanying enlargement of a photograph of Saturn, by MM. Henry at Paris, like the photographs of star-fields in preceding numbers of KNOWLEDGE, has received no touch from the hand of any human engraver. It is Saturn's own work. In that sense it is full of promise. Next month we hope to introduce a photographic engraving of Jupiter, by Jupiter.



SATURN SELF-PHOTOGRAPHED.

FIFTEEN SCHOOL-GIRLS.

A CORRESPONDENT asks for a solution of the problem of the fifteen school-girls who —to avoid plots against the peace of the community (of which school-boys would naturally be innocent)—were to walk day after day in sets of three, in such a way that no two would be in the same set more than once in seven days. Solutions will be found in Volume II., and a discussion of the puzzle there and in Volume III. We will give the solution next month, when we may also consider the general principles involved in such puzzles.

There is a puzzle of the kind, by no means so easy as many might imagine, which is of frequent occurrence in a practical way:—

Given $2n$ chess players; how are they to be arranged in pairs so that there may be $(2n-1)$ sittings, each of n games, all the players being engaged at each sitting?

By beginning with an easy problem of pairs, problems relating to sets of three, four, and more may be readily dealt with.

Here is an example of the more difficult sort:—

There are sixteen whist players; how may they sit down to five different games so that no two may take part together (either as partners or adversaries) in more than one game?

Gossip.

By Richard A. Proctor.

A correspondent asks whether in my article on a "Dead World" the sentence beginning "Sulphurous acid might be as innocent as rose water," &c. (July number of Knowledge, p. 283), "does not imply that sulphurous acid and vitriol are the same substance"? I should be grieved to suppose so. Sulphurous acid and vitriol are distinct, but sulphuric acid may be obtained chemically from sulphurous acid, and as a matter of geological fact, sulphuric acid is nowhere found in nature free, except in the neighbourhood of volcanoes. It appears probable that this sulphuric acid, which is only found at active vents, is formed under such conditions as exist in such spots from the sulphurous acid which is more widely found. Or it may be liberated from sulphides of the metals. If we consider the occurrence of sulphuric acid in the rain falling in towns and manufacturing districts, we shall see reason to believe that during the times when the earth's volcanic activity was very much greater than now, vitriolic rain fell in considerable quantities.

* * *

As to the effect of rains in which sulphuric acid is present, we need only note that even the small quantities present in the rains of our time cause the corrosion of metallic surfaces, stones, mortar, and so forth. Angus Smith remarks that the mortar of walls may often be observed to be slowly swelling and dropping out, owing to the conversion of the lime into sulphate.

* * *

Probably, in the sentence referred to, I intended to write sulphuric acid; but sulphurous acid need not have been misunderstood, I think, since its presence implies conditions under which sulphuric acid would certainly be present also. Roth, "Chemical Geology," p. 452, remarks that sulphurous acid and sulphuretted hydrogen are sometimes oxidised into sulphuric acid, which remains free in the water of springs.

* * *

The same correspondent writes as follows on another subject:—

"If occasion should offer itself for making any further reference to Josephus's supposed testimony to Jesus Christ, I should be glad if you would say whether the passages referring to James the Just as the brother of Jesus, *who was called Christ*, are considered genuine or not. The following passage I have seen quoted, but have not succeeded in finding in the text: 'These miseries befell the Jews by way of revenge for James the Just, who was the brother of Jesus that was called Christ, on account that they had slain him, who was a most righteous person.'

"The stoning of James is related in 'Antiq.' book xx., ch. ix., and he is there referred to as 'the brother of Jesus, who was called Christ.' I have seen no reference to these passages in anything you have written about Josephus in Knowledge, and they have only recently come under my notice, otherwise I should have written to you about them before. Now, I fear, you will probably not care to reopen the subject again."

* * *

I know of no such passage as our correspondent quotes. It seems to me probably a quotation from memory (incomplete) of the passage relating to John the Baptist, where, however, Herod's defeat (not Jewish misery) was attributed by the interpolator to the murder (quite impossibly altered in details of place and time) of John, not of James. "Some of the Jews thought" Herod's defeat was "a punishment for what he did against John—who was a good man," &c. The stoning of "James, the brother of Jesus, who was called Christ," is mentioned in the "Antiquities," book xx., chap. ix., § 1. It is unfortunate that the interpolator, who came a little late to his work, after the absence of a single word in Josephus relating to Christ had been thoroughly recognised by Christian apologists, was not aware of the fact that the James referred to was certainly mentioned elsewhere as alive long after he was delivered to the sanhedrim by Ananus to be stoned. Whiston, indeed, would have us believe that the account as worded does not and cannot signify that James actually was stoned. But Josephus certainly would have told us if the sentence had not been carried out. On the contrary, he says that the most equitable of the citizens disliked what was done, and sent to King Agrippa desiring him to send to Ananus that he should do so no more. The interpolator of words by which the actual James was stoned by order of Ananus or Ananias was altered into another James, described as a brother of Jesus (in turn altered by theologians into a "cousin!"), should have added another line, explaining that James was restored to life.

* * *

I may take the opportunity afforded by my correspondent's request to note that, mysterious though the silence of Josephus may seem in regard to events described as having happened in the city of his birthplace, and a few years only before his birth, the silence of Philo is more mysterious still. He was about sixty years old, according to his own account (written about A.D. 40), at the reputed date of the Crucifixion. Unhappily, no follower of Eusebius (the first to quote the interpolated passage about Christ in Josephus) seems to have thought of applying that devout man's principle that "it is lawful to lie and cheat for the cause of Christianity" to the works of Philo the Jew. So that a Christian apologist of our own days, the Rev. Dr. Giles, in his "Hebrew and Christian Records," vol. ii., p. 61, is compelled to write in the following melancholy strain:—

Great is our disappointment at finding nothing in the works of Philo about the Christians, their doctrines, or their sacred books. . . . His silence is the more remarkable, seeing that he was about sixty years old at the time of the Crucifixion, and, living mostly in Alexandria, so closely connected with Judæa and the Jews, could hardly have failed to know something of the wonderful events that had taken place in the city of Jerusalem,—

assuming always that those events had really taken place as described nearly a century later.

* * *

A scarcely less mysterious puzzle is the silence of Pliny the Elder, Seneca, Diogenes Laertius, Pausanias, Tacitus, Suetonius, Appian, Justin, Ælian, and others, who might have been expected to make some remarks about Christianity, had its beginnings been such as are commonly described.

* * *

Tacitus, of course, is credited with a reference to Christians, "malefactors called after Christus, who, in the reign of Tiberius, was put to death as a criminal by the procurator Pontius Pilate." Unfortunately this passage is not referred to by *any* of the Christian fathers, though several of them were readers of Tacitus, and some of them had specially searched his works for just such support as the passage would have supplied. Thus, Tertullian, who died about A.D. 220, much needed such evidence (see his 'Apolog.' ch. 5); but with all his study of Tacitus (not a very voluminous writer), he knew of no passage relating to the Christians in Tacitus's time (say A.D. 55 to A.D. 117). Neither did

Clement of Alexandria, who had set himself the task of hunting out all such references. Not even Eusebius had found this passage; nor had he (in face of the fact that the MSS. of his day had been notoriously searched in vain for such a passage) the courage to invent it. Yet he wanted not that sort of courage by any means. Justin Martyr, in A.D. 141, addressing the Roman people, the senate, and the emperor in defence of Christianity, could adduce no such evidence; yet if he could it would have been worth a hundred such arguments as he used (though that, perhaps, is not saying much). "As to the objections," he writes, "about our Jesus being crucified, I say,"—*not* "your own Tacitus says he was crucified, and by Pilate, even as our historians say," but simply and most feebly—"suffering was common to all *your* sons of Jupiter, so why should not *our* son of Jupiter suffer"? There is, in fact, no trace of the passage before the fifteenth century. The very use of the word "Christ," as if it were a name, like the incorrect use of "Buddha" for "the Buddha," shows that the passage is an interpolation by some ignorant person, who certainly carried out his pious fraud at least 300 years after the time of Tacitus, and probably much later even than that. The Romans were not intolerant in religious matters; and most probably the malefactors referred to in the passage as it originally stood were really evil men—not Christians at all, even in name.

* * *

The following jest ought to be good, seeing that it was made nearly a year ago in the *Saturday Review*, and is now repeated for my special benefit and delectation, as something too fine to be forgotten, in the sweetly honest critique of my "Americanisms," on which I have touched elsewhere in this number. My critic, by the way, expresses astonishment that I "have not hesitated to reprint the jibe of an enemy" about "*le savoir c'est moi*"—see Gossip for May, p. 228. So like a *Saturday Reviewer* to regard a jibe as the work of an enemy! My critic's astonishment at my repeating the joke is as characteristic of him as—I trust—my own action is of me. Anything like frankness, or fairness, or a sense of fun for its own sake, must seem so strange to a man like my critic. I doubt very much whether the man who made the neat joke about *le savoir c'est moi* meant to hurt me. There was too much good fun in the joke for that. Any way I hold, now as always, that a joke about myself is as well worth repeating as another, if good as a joke, whether it is a sooth jest or not. There is much less fun in the laboured joke—smelling of the dictionary—elaborated by my *Saturday Review* critic, who in assuming that a jibe must come from an enemy, writes himself down one—where I write him down rather a false friend.

* * *

"We suggested to Mr. Proctor the cultivation of a marine mongoose to kill off the sea serpents which seem to inhabit the seven-leagued boots with which he strides across three continents disseminating very popular science." Country and colonial papers please copy, for the *Saturday Review* regards this as a superior joke! I commend it specially to Mr. Grant Allen, whose proposition in the *Cornhill Magazine* about a year ago, that a sea serpent should be put into one of our museums, seems to mark the incubation of this very funny suggestion. I ventured a smile at that embryonic jest, as I now venture to laugh at it in its full-grown form.

* * *

I would not, however, advise my critic, or any of his readers, to imagine that *very* popular science will suffice to make tri-continental lecturing successful. I fancy I remember cases in which "very popular" science-mongers have been very great failures on the platform. My own plan is to suppose my audiences very critical—Darwins, Tyndalls, and Huxleys, come to hear a subject about which they have no special or technical knowledge—and beyond the omission of technicalities I do not know that my lectures can be properly called popular. I would recommend my critic, if he would attain better success on the lecture platform than has yet rewarded his exertions, to try the following mixture:—First, long and loving study of some subject; secondly, real enthusiasm for it; and thirdly (what I am told some lecturers lamentably want), respect for his audience.

* * *

The mongoose, in this "jibe of an enemy" (I thank thee, friend, for teaching me the word), reminds me of a mongoose story, which I have heard in various forms, and now repeat (throwing in Americanisms) as it was told me by a charming fellow-passenger — an American lady — on the *Germanic* a few weeks ago. (It will bear repeating, though probably many of my readers have already heard it):—

A "down-east Yankee" sat in a street-car opposite a quiet-looking man who carried a bag. Overcome at length by innate inquisitiveness, the Yankee asked—

Yankee: "Say, stranger, what air you carrying in thet ther bag?"

Stranger: "Ssh—sh! Don't tell! A *mongoose*!"

Yankee: "I *want* to know! But—say stranger—*what's* a mongoose?"

Stranger: "A mongoose is a *Macauco*, or *Maki—genus Lemuridæ*. It kills snakes."

Yankee: "Du *tell*! But—say stranger—what snakes are you going to kill with this yer—this yer—mucky—mongoose?"

Stranger (*solemnly*): "I have a brother. He sees snakes! I'm taking along this mongoose to kill those snakes!"

Yankee: "Sakes *alive*! But—say stranger—them snakes ain't real!"

Stranger (*descending sadly from the car*): "I know it. But then—you see—this mongoose isn't real either." *Exit.*

Yankee (*reflectively*): Wal! Darn my *mother*!!"

* * *

"The bearings of this" fable "lays" (as, alas! too many Americans say) "in the application on it." The *Saturday Review* criticism is the mysterious bag. Any one who expects to get truth out of such a *critique* may be aptly compared to the unwise Yankee; the mongoose is my critic's wisdom; my critic is the demented brother; and the snakes seen by the crazy brother are the faults my critic notes in my "Americanisms." I show elsewhere that the faults "ain't real"; "but then—you see"—my critic's wisdom "ain't real" either.

* * *

A correspondent asks whether the surgical operations, on which the interest of Mr. Grant Allen's shilling shocking "Kalee's Shrine" chiefly turns, are possible: whether the eyelids can be permanently prevented from working by cutting two nerves, or put into working order again by cutting two more. I cannot imagine how the former operation could be effective for more than a few days, or how, if the former were possible, the latter could be effective at all. It would seem about as likely that if an *extensor* muscle were cut through, and then the corresponding *flexor* were also cut through, the person experimented on would be just as well off as if he had not been touched. But I would not venture an opinion on a subject outside my range, lest haply some *Saturday Review* critic should accuse me of writing "with delightful self-satisfaction" about matters whereof I know nothing. Mr. Allen introduces so many surgical matters into his stories that I make no doubt he has studied surgery very thoroughly indeed.

I wonder what my good friend Mr. Browning, whose excellent little treatise on the eye has just, I see, received high and well-deserved praise in *Truth*, would say about the "Kalee" eye story. The only ophthalmic story I care to speak about myself, just now, is that old one which relates how a critic was told to cast a beam out of his own eye that he might see more clearly to remove a mote from another's.

The *Times* of August 16 gives the prominence of leaded type to a puff of Mr. Romanes's paper on "Physiological Selection" read before the Linnean Society in May last, in which a theory is presented in explanation of the problem of the sterility of species at a certain stage in the evolution of varieties. Mr. Romanes finds the key in the subtle action of variation on the reproductive system, but his theory has the not slight defect of being as yet unsupported by facts; these, however, he proposes to collect by systematic observation of many species.

* * *

Mr. Romanes's friend claims him as the Elisha on whom Mr. Darwin's mantle "has most conspicuously descended." Now, we are not sure that Mr. Romanes has Mr. Darwin's mantle, but we are sure that he has neither his modesty nor his method. His paper is a vicious example of self-laudation, with covert inferences that Mr. Darwin's fact-proven theory is related to his factless theory in the sense that the imperfect covenant of the Old Testament is related to the perfect covenant of the New. So anxious is he, representative of this age of scramble after notoriety, to get to the fore, that he has no thought of copying the patience of the great master who sifted mountains of fact before announcing his memorable explanation of the mutability of species. And, in the absence of the yet uncollected facts to prove not that Physiological Selection *must be*, but *is*, the *Times* writer makes the damaging admission—not surprising to those who know Mr. Romanes's unstable equilibrium in matters theological—that his theory is "quite capable of being reconciled with some views of special creation."

* * *

The *Times* of September 2 refers to the theory as causing "excitement" among biologists, but it appears to have been practically dismissed at the British Association meeting. Mr. F. Darwin's references to the "Origin of Species" in *Nature* of September 2 show that the originality claimed by Mr. Romanes is baseless, and the theory has received its *coup de grace* at the hands of the highest living authority on the subject, Mr. A. R. Wallace, in the September number of the *Fortnightly Review*.

* * *

He alone may claim equality with Darwin who solves the great *crux*—the causes and conditions of variations.

The papers on "The Unknowable" may be regarded as closing, so far as their serial form is concerned, with the present number.

* * *

We propose to begin with the November number (the first of Volume X.) a series of maps of the whole earth, on one scale—the first such series ever produced, to the best of our knowledge, in which the whole earth has been shown on a uniform plan, to one scale, and almost without distortion. The series will, we believe, be very useful for students of history and travel, as well as for students of geography, for whom it is specially intended.

* * *

We have by no means forgotten our promise to bring out a series of star maps showing the southern skies, month by month, as we have already shown the northern skies, in "The Stars in their Seasons," and more simply in "The Star Primer." The engravers to whom our first maps were entrusted seemed to find pleasure in thwarting our plans by delays and blunders. We found also some complaints arising because the maps were late for the southern hemisphere. We propose, therefore, to make a fresh start on a new plan, with the engravers who now carry out our wishes.

* * *

We would invite the special attention of whist-players to the "Whist as Taught by Mathews," which we propose to begin with our November number. Mathews may be regarded as of all writers on whist the one by whom whist *strategy* has been most intelligently and originally dealt with.

Reviews.

Elements of the Comparative Anatomy of Vertebrates. Adapted from the German of Prof. Wiedersheim. By W. Newton Parker. (Macmillan.)—This work may be regarded as an admirable supplement to Gegenbaur's "Elements of Comparative Anatomy," which the same publishers issued a few years ago under the editorial care of Prof. Ray Lankester. A distinguishing feature of the book is the number and completeness of the illustrations, especially those showing the circulatory systems, which are printed in different colours. The arrangement of the chapters according to organs, instead of according to groups of animals, assumes a general acquaintance with biology on the part of the student; but as emphasising the fact of an evolution of organs as well as of animals, such arrangement is of the first importance. As the translator, while retaining the plan of the original, has made numerous additions to and modifications in the work, rendered necessary to bring it up to time, we had hoped to have found more detailed reference to the origin and genealogy of the monotremes, whose place in descent is referred to elsewhere in these columns. But we tender Prof. Newton Parker ungrudging thanks for the good and valuable service rendered in making Wiedersheim's book accessible to English students.

The Elementary Principles of Electric Lighting. By Alan A. Campbell Swinton. (London: Crosby Lockwood & Co. 1886.)—This little book may be heartily recommended to all who wish to understand the principles of electric lighting without entering into the mass of technical and mathematical detail which usually encumbers works on the subject of which it treats. Clearly written and well illustrated, it contains a thoroughly intelligible explanation of the whole matter within the limits of twenty-nine pages.

A Practical Manual of Wood Engraving. By Wm. Norman Brown. (London: Crosby Lockwood & Co. 1886.)—Here is another capital work for the incipient learner. Mr. Brown presupposes no previous knowledge whatever on the part of the student, but begins at the very beginning. After a brief historical introduction, he describes every tool which the pupil will require, and the mode of its use, following this up, with examples and "copies" for him to practise. The book is fully illustrated.

Photo-Micrography. By I. H. Jennings. (London: Piper & Carter. 1886.)—The microscopist who may wish to obtain absolutely trustworthy delineations of objects and structure revealed by his instrument is now no longer confined to the difficult and uncertain use of the camera lucida and the lead pencil for this purpose, but finds in the

resources of modern photographic art all that is needful for his purpose. Mr. Jennings's *brochure* will be found handy by all who are entering on this fascinating pursuit, as he describes instruments, processes, and objects in considerable detail. Dr. Maddox contributes a chapter on preparing bacteria. Illustrations from photographs, as also from ordinary wood blocks, appear wherever they are required to elucidate the text.

Partiality in Unity; or, A View of the Universe. By "ONE OF ITS PARTS." (London: Wyman & Sons. 1886.)—The author of this work, brooding over the mystery which has puzzled wiser heads than his own, supposes himself to wander forth on a summer night and hold converse with a "stranger." This conversation is carried on throughout in blank verse, at the end of 1,400 lines of which the "Mortal"—or author—arrives at the original conclusion that "Humility alone is peace." His end thus being peace, it only remains to remark that neither mortal nor immortal seemingly possesses the most rudimentary idea of scanning.

Algebra for the use of Schools and Colleges. By WM. THOMSON, M.A., B.Sc., &c. (London: Sampson Low, Marston, Searle, & Rivington. Cape Town: J. C. Juta & Co. 1886.) *The Elements of Plane Geometry.* Part II. (corresponding to Euclid, Books III., IV., V., VI.) (London: Swan Sonnenschein, Lowrey, & Co. 1886.) *Arithmetical Exercises.* By F. C. HORTON, B.A. (London: Seeley & Co. 1886.)—Of making many (school) books there is seemingly no end. Our table is rarely free from them, and "the cry is still 'They come!'" Of the three whose titles head this notice, Mr. Thomson's *Algebra* may be commended for its thoroughness. It seems somewhat too abstract in places for the incipient learner, but as it is intended for colleges—and is, in fact, the text-book at the University of the Cape of Good Hope—it is not difficult to see on what ground this might be defended. The second work on our list is prepared by the Committee of the Association for the Improvement of Geometrical Teaching. With reference to it we may remark that while some of the theorems are simplifications of those of Euclid, and a few of the proofs distinguished by a certain amount of neatness, in other cases we fail to see any improvement whatever on the demonstrations contained in the immortal work of the mighty Alexandrian geometer. Mr. Horton's examples seem judiciously selected.

THE FACE OF THE SKY FOR OCTOBER.

By F.R.A.S.

THE sun may be looked at on clear days for the spots and faculæ which from time to time appear in diminishing size and numbers on his face. The Zodiacal light is now visible in the East before sunrise. The night sky is delineated in map x. of "The Stars in their Seasons." Minima of the variable star Algol ("The Stars in their Seasons," map xii.) will occur on the 1st, thirty-one minutes after midnight; on the 4th at 9h. 20m. P.M.; on the 7th at 6h. 9m. P.M.; on the 24th at 11h. 3m. P.M.; and on the 27th at 7h. 52m. P.M., other minima happening at very inconvenient hours. Mercury is an evening star, in so far that he souths after the sun, but he is very badly placed for the observer throughout the month. Venus is a morning star throughout the month, but is in an indifferent position, and is becoming a very insignificant object. Mars, Jupiter, and Uranus are all three invisible. Saturn is a morning star, but he rises about 10h. 45m. P.M. on October 1, and before nine o'clock at night at the end of the month. He forms a right-angled triangle with δ and κ Geminorum ("The Stars in their Seasons," map ii.). Neptune is a morning star, but he may be fairly seen during the working hours of the amateur observer's night, as he rises before half past five in the evening at the end of October. He is about 6° south of the Pleiades in a perfectly blank part of the sky. The moon enters her first quarter at 10h. 33·6m. on the night of the 4th, and is full at 3h. 23·9m A.M. on the 13th. She enters her last quarter at 2h. 40·8m. o'clock in the afternoon of the 20th, and is new at 7h. 15·5m. A.M. on the 27th. No less than eleven occultations of stars by the moon will be visible at convenient hours during the month. On the 6th, B. A. C. 7097, a star of the 6th magnitude will disappear at 10h 33m. P.M. at the dark limb of the moon at an angle from her vertex of 112°. It will reappear at her bright limb at 11h. 42m. P.M. at an angle of 312° from her vertex. On the 12th, *f* Piscium, a 5½th magnitude star will disappear at her dark limb at 11h. 58m. P.M. at a vertical angle of 40°, reappearing at 12h. 15m P.M. at an angle of 19°. from the moon's vertex. On the 14th, μ Ceti, a 4th magnitude star, will be occulted as it is rising. It may afterwards be seen to reappear at 7h. 1m. P.M. at the dark limb of the moon, at an angle of 272° from her vertex. On the 16th, θ^1 and θ^2 Tauri, both stars of the 4½th magnitude, will be behind the moon when she rises. The former will reappear at 7h. 1m. P.M. at an angle of 272°, the latter at 7h. 36m. P.M. at an angle of 216° from her vertex; both, of course, at her dark limb. Later on, 80 Tauri, a 6th magnitude star, will disappear at her bright limb at 7h. 25m., at an angle of 24° from her vertex, and reappear at 8h. 4m. P.M. at her dark limb, at a vertical angle of 287°. Then at 7h. 36m., 81 Tauri, of the 5½th magnitude, will disappear at the bright limb of the moon, at an angle of 32° from her vertex. It will reappear at her dark limb at 8h. 20m. P.M., at an angle of 279° from her vertex. The last occultation on this night is that of 85 Tauri, a 6th magnitude star, which will disappear at the bright limb at 8h. 5m., at an angle of 53° from the vertex of the moon; and will reappear at her dark limb at 8h. 59m. P.M., at a vertical angle of 255°. Before the moon rises the next night (the 17th) she will have occulted 111 Tauri, of the 5½th magnitude. The star will reappear at her dark limb at 8h. 14m. P.M., at an angle of 240° from her vertex. Afterwards, at 9h. 9m. P.M., 117 Tauri, a star of the 6th magnitude, will disappear at her bright limb, at a vertical angle of 339°; reappearing at her dark limb at 9h. 17m. P.M., at an angle of 322° from her vertex. The remaining occultations occur during the morning hours. At noon, on October 1, the moon is in Libra, but at 5h. 30m. P.M. arrives on the boundary of the narrow northern strip of Scorpio ("The Seasons Pictured," plate xxvi.) By 2h. 30m. A.M., on the 2nd, she has crossed this and passed into Ophiuchus. Her path across Ophiuchus is completed by 9 P.M. on the 3rd, and she then enters Sagittarius. She quits Sagittarius for Capricornus at 9 A.M. on the 6th ("The Seasons Pictured, plate xxi.), and the last-named constellation for Aquarius 9h. 30m. A.M. on the 7th. She is travelling through Aquarius until 3h. 30m. P.M. on the 10th, and then she enters Pisces ("The Seasons Pictured," plate xxii.). She does not leave Pisces until 10 P.M. on the 13th, at which hour she passes into the north-east corner of Cetus. By 11 o'clock the next morning she has traversed this and entered Aries ("The Seasons Pictured," plate xxiii.). At 2h. 30m. P.M. on the 15th she crosses the boundary between Aries and Taurus. In her journey through Taurus she arrives at 8h. A.M. on the 18th, at the most northerly outline of Orion. It takes her twelve hours to cross this, and at 8 o'clock the same evening she emerges in Gemini ("The Seasons Pictured," plate xxiv.). Her journey through Gemini terminates at 1 P.M. on the 20th, and she then enters Cancer. At 12h. 30m. P.M. on the 21st she quits Cancer, in turn, for Leo. She passes out of Leo into Virgo at noon on the 24th ("The Seasons Pictured," plate xxv.), and from Virgo into Libra at 8h. 30m. A.M. on the 27th. Traversing the last-named constellation, she arrives, as she did at the beginning of the month at the northern apex of Scorpio ("The Seasons Pictured," plate xxvi.), at 4 A.M. on the 29th. At 1 o'clock the same afternoon she emerges in Ophiuchus. She is passing through Ophiuchus until 6 A.M. on the 31st, when she crosses the boundary into Sagittarius. There we leave her.

WHIST.

By "FIVE OF CLUBS."

THE Whist Editor of the *Australasian*, whose skill is well known (he has read me more than one lesson by which I have profited) has obligingly sent me the following game, with the notes—except those within brackets, which are mine. I have ventured to alter his *W* and *X* into *Y* and *Z*. (I cannot understand why, using the first two letters of the alphabet for one pair of partners, he should not use the last two for the other pair, but *W*, the last but three—and an awkward letter any way—with *X*, the last but two.)

ILLUSTRATIVE WHIST HAND.

(Originally Published in the "Australasian.")

A B play against *Y* and *Z*. Score :—*A B* two; *Y Z* love.

The Hands.

B { H. (*trumps*).—Kn, 10, 7. S.—7. C.—Q, 7, 4, 3, 2. D.—K, 9, 7, 2. }

Y { H. (*tps*).—6, 4. C.—Kn, 10, 5. D.—10, 5, 3. S.—3, 4, 5, 10, K. }

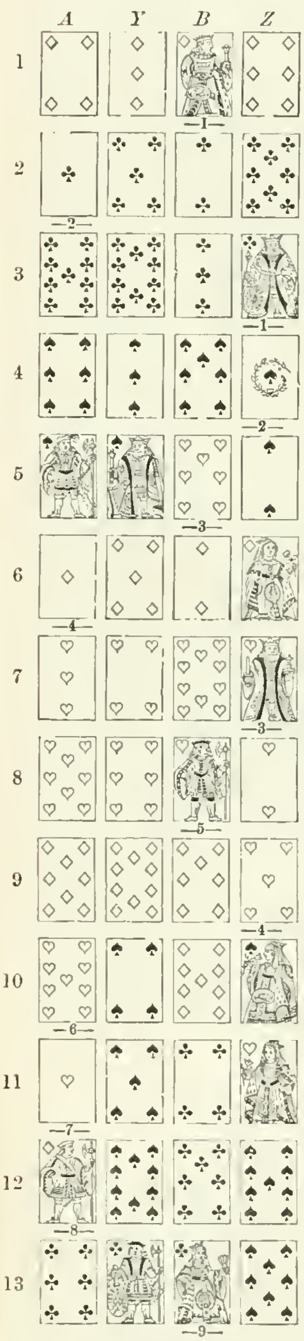
B

Y *Tr.* H. Q. Z

A leads.

{ H.(*tps*).—2, 5, Q, K. C.—8, K. D.—6, Q. S.—2, 8, 9, Q, A. } *Z*

A { H (*trumps*).—A, 9, 8, 3. S.—Kn, 6. C.—A, 9, 6. D.—A, Kn, 8, 4. }



and *A B* score three by cards and the game.

NOTES ON THE PLAY.

Card underlined wins trick; card underneath leading next.

Trick 2. *B* is a player who sets his face against penultimates and American leads.

Trick 3. *B* does not cover Club Ten. For the Club King is certainly not in *A*'s hand, and the probability is that it is not with *Y*. Again, the fall of the Clubs Eight, Nine, Ten shows that *Z* must either hold King sole, or else King Knave. Hence *B* has no choice but to pass *Y*'s Club Ten.

[*Z* appears also to object to the American leads, according to which (as distinguished in this case from the penultimate) he would here have led the 8.]

Trick 7. *A* having Ace and three other trumps, with Diamond strength in his own hand, and Club strength in his partner's, ventures on a trump lead. [Besides, it is clear that by leading trumps he will put *Z*, who has no Clubs or Diamonds, into a difficulty, if he wins the trick, or probably get the Ten-Ace over the Queen if *B* holds the King.] *Z* ought to have won this trick with the Queen, not with the King. Why should he have gone out of his way to make it easy for *A* to count the trumps? [May not *Z* have intended by this indication of length to warn *Y* against forcing him?]

Trick 8. *Z* is in a difficulty. He must lead either a Spade or a Heart, and of the two the Spade looks the better lead. [I must confess I differ here from the whist editor of the *Australasian*. A Spade lead would probably enable *B* to ruff, and thus force *Z*, which is what *Z* wants most to avoid *A*'s play of the Eight is good. If *B* has any other trump it must be the Knave (thanks to *Z* for showing this); and if *B* has no other trump, the game cannot be won by any play.] Nevertheless, even the Spade lead will not save the game, as is shown by the following two possible variations of the play :—

Variation I.

	A	*Y*	*B*	*Z*
Trick 8. . .	C 6	S 4	H Kn. —5—	S Q
„ 9. . .	H 8 —6—	C Kn	C Q	H 2
„ 10. . .	H A —7—	H 6	C 4	H 5
„ 11. . .	D Kn	D 10	D 7	H Q —4—
„ 12. . .	H 9 —8—	S 5	C 7	S 8
„ 13. . .	D 8	S 10	D 9 —9—	S 9

Variation II.

	A	*Y*	*B*	*Z*
Trick 8. . .	C 6	S 4	H Kn —5—	S Q
„ 9. . .	D 8	C Kn	C Q —6—	S 8
„ 10. . .	H 8 —7—	S 5	C 7 *	S 9
„ 11. . .	D Kn	D 10	D 7	H 2 —4—
„ 12. . .	H 9 —8—	H 6	C 4	H 5
„ 13. . .	H A —9—	S 10	D 9	H Q

It is clear also that, if at trick 9 of the first of these variations, *Z* trump with the Heart Queen, instead of the Heart Two, he will lose all the remaining four tricks.

The whist editor of the *Australasian* also forwards me a discussion of the question whether honours can be counted, if not claimed, before the trump is turned to a completed misdeal. Such points are interesting as matters of curious discussion, though I think real lovers of whist are apt to regard the laws as of interest only for those who think more of the stakes than of the game. The paper opens thus :—

A DIFFICULT POINT OF WHIST LAW.

By the Whist Editor of the "Australasian."

I was recently asked to decide whether honours could or could not be scored after a completed misdeal. After careful consideration of the points involved, I ruled in the negative; and, at the same time, I gave the reasons on which I based my conclusion. Shortly afterwards one of the best whist-players in Melbourne intimated to me that he "dissented entirely" from my view. He wrote to me in the following terms :—"The club code is distinct. Rule 6 is that 'Honours, unless claimed before the trump card of the following deal is turned up, cannot be scored.' I contend that honours can be claimed before the completion of the deal following the misdeal—first, because a misdeal is not a deal; and secondly, because they are claimed before the trump card of the following" [valid] "deal is turned up, inasmuch as there cannot be a trump in a misdeal. I fully agree with your remarks as to the desirability of a settlement of the score before the cards are cut for the following deal. So long, however, as the present code governs the game of whist, we should not depart from a clearly worded law, whatever the original intention may have been." I am in entire accord with the views expressed in the concluding sentences of the preceding note. It is my invariable practice to base my whist rulings, if possible, on the very letter of the club code; and I never hesitate about refusing to be bound by the decisions of referees who have allowed themselves a wider latitude. But at the same time it must be borne in mind that the framers of the club code have not defined many of the technical terms which enter into the nomenclature of the game; and that they have even used some of these terms in more than one sense. Hence, it frequently happens that in deciding a whist case, the first business of the referee is to make up his mind in regard to the exact meaning, as distinguished from the popular interpretation, of one or more of the whist laws. In the case under consideration I had satisfied myself that the phrase "following deal," which occurs in Law 6,

* Would *B* go on with Clubs at the risk of forcing the trump leader unfavourably? Not knowing *Y*'s weakness in trumps, it seems to me *B* would here go on with Diamonds; in which case *Z* would make his Heart Two, and, forcing *A* with a Spade, would make another trick with his guarded Queen, and save the game.

ought to be construed as "deal of the following player," and had decided that if honours had not been "called" previous to an abortive attempt, which had deprived that "following player" of his deal, they could not be scored. On finding, however, that a competent authority had dissented from my ruling, I appealed to a friend who occupies a judicial position in New South Wales, and who is one of the best whist-players in that colony, requesting him to give me his opinion on the points at issue. I wrote to this friend as follows:—"It appears to me that the term 'claiming to score honours' is not necessarily identical in meaning with the requirement that 'at the end of a hand' players shall 'call' the honours which they allege that they have held. Strictly speaking, the latter phrase directs that, while all the facts are quite fresh in the memory of all the players, two of them shall 'audibly name' the cards on which they base their claim to score honours. In practice, no doubt, this requirement of the club code is not exactly obeyed. This, however, is a mere matter of convenience, and not, so far as I can see, because two different phrases, which are used without definition in two successive whist laws, are necessarily identical in meaning. Again, I cannot acknowledge that 'a misdeal is not a deal.' The club code expressly provides that—in the absence of certain circumstances, each one of which is explicitly specified—'a misdeal loses the deal.' Consequently, it is more than a 'not-deal,' or mere negation of a deal. In fact, according to my view, it is the 'following deal' of Law 6—abortive, it is true, inasmuch as the cards distributed to the players are not played, but nevertheless complete to this extent that, in consequence of its occurrence, the deal passes to the player on the left of the one whose proper turn it is to deal. It is because of this effect of a misdeal that I feel certain in regard to its barring the scoring of honours, which the law requires to be called at the end of any hand, in respect to which the claim to score them may arrive. But inasmuch as a whist-player, who stands in the first rank, has protested against my decision, I shall feel obliged by your examining the case, and by your obliging me with your opinion in reference to the points at issue." I may add that I had said in my published ruling that "it is a matter of custom and convenience to regard the phrase 'end of the hand' as being synonymous with the interval which is occupied in dealing, and during which play is suspended. Hence, there can be no doubt that in the event of W's attempting to deal with an important pack, and subsequently insisting on his right to a new deal, A and B's claim to score honours would not be disputed, provided the claim were made antecedent to the completion of W's new deal. Such new deal, however, is the 'following deal,'—that is to say, 'the deal of the following player'—of the club code; but, manifestly, this is not the case in regard to the deal which passes from A to B, in consequence of W's having misdealt." I had also said that my remarks might be regarded as implying that "when a player deals out of his turn, the right of scoring honours should lapse, in case of their not having been called immediately after the conclusion of the preceding hand. But it is obvious that this objection admits of the reply that at any time antecedent to the completion of such deal in error, the proper dealer can insist on dealing. Hence this mistake is altogether different in character from a misdeal, which deprives the 'proper dealer' of the right to deal." Then, in conclusion, I had expressed the hope that "among the amendments to be made hereafter in whist law will be the enactment of an explicit rule that all questions of score shall be settled before the cards are cut for the following deal."

For the rest of the paper we have not at present space. The reply of the New South Wales player is rather voluminous, and leads to a still more voluminous rejoinder. The whole matter seems to me included in the consideration that the object of the law is clearly to insist that honours must be claimed between the close of the play to the hand whereunto they belong, and the beginning of the play of the next hand. As this play does not commence after a misdeal, completed or otherwise, the contention of the whist editor of the *Australasian* appears to me to be unsound. The law is not a pleasant one, any how. The practice should be to attend to the score, and settle all about it before cutting for a fresh deal. And were it not for the weary waste of words so often following the play of a hand this would always be easily managed.

MATHEWS ON WHIST.

We propose to begin in our next a series of papers on the fine strategic whist of Mathews, re-arranging his maxims (which they much need), explaining matters where his writing is obscure, and pointing out where modern whist departs from the whist of Mathews' days (apart from those merely conventional arrangements which many fondly imagine to constitute the science of whist as now played).

Our Chess Column.

By "Mephisto."

ENGLISH PROBLEM COMPOSERS.

II.—A. E. Studd.

We have much pleasure in continuing our series of articles on English problemists by reproducing the masterly compositions of Mr. A. E. Studd. It will be seen from the specimens published below that the composer is versatile in all branches of problem composition. He has the clever gift of making difficult problems by using the pieces freely, but his problems never seem overburdened, and mostly represent masterly conceptions, in which all the parts harmonise with the whole idea in a pleasing manner. This is exemplified, amongst others, by problem No. 1, where, in spite of Queens, Rooks, and other pieces, the Black King is given the utmost freedom of action, and the final mate occurs in the purest possible manner, one move with the Knight cutting off no less than four squares of the Black King.

In order to appreciate the fine points in these problems we strongly recommend our readers to make a fair attempt to solve each particular problem before looking at the solution.

No. 1 Position.

White—K on Q2. Q on K Kt2. R on QBsq. Kt's on KB3, QB4. B's on QKt3, Q6. P's on K Kt5, KB6. (Nine pieces.)

Black—K on Q4. Q on KBsq. R on Q2. Kt on KR4. P's on K Kt3, QB2, QKt3, 5. (Eight pieces.)

Mate in two moves.

No. 2 Position.

White—K on QR2. Q on K Kt7. R's on KB6, QB4. Kt's on QB2, 6. B's on QR5, K8. P's on K2, 5, QR4. (Eleven pieces.)

Black—K on Q4. R on Q2. Kt on QB4. B on K3. P on KB5. (Five pieces.) Mate in two moves.

No. 3 Position.

White—K on QB6. Q on QKt5. R's on KR sq, K7. Kt's on KKt4, K5. B on QR sq. P's on KR5, KB2, 6, 7. (Eleven pieces.)

Black—K on KKt4. P on KR2. (Two pieces.)

Mate in two moves.

No. 4 Position.

White—K on QKt sq. Q on KR8. R's on Q sq, QB3. Kt's on KKt3, K3. B on QB7. P's on KKt2, KB6, K6, QKt5, QR2, 3. (Thirteen pieces.)

Black—K on Q5. Kt on Q6. B on Q7. P's on QKt2, 3. (Five pieces.) Mate in two moves.

No. 5 Position.

White—K on KR4. Q on KB2. R on KKt5. Kt's on QKt2, 5. B's on K5, QKt7. P on QB6. (Eight pieces.)

Black—K on Q4. R's on K6, QR sq. Kt's on KR3, K3. B on QKt5. P's on K5, Q6, QB2, KR6. (Ten pieces.)

Mate in three moves.

No. 6 Position.

White—K on KR sq. Kt on Q sq. P on QR2. P on KB3. B on KKt4. Kt on K4. B on Q6. Q on QB6. R on KB8. (Nine pieces.)

Black—B on QKt sq. R on QR2. P on K3. P on KKt4. B on KB4. Kt on K4. P on QKt4. P on KR5. K on KB5. Kt on QB5. P on QKt6. P on KR7. (Twelve pieces.)

Mate in three moves.

No. 7 Position.

White—B on KB sq. R on QR sq. K on Q2. P's on KB3, QB3, KR4, KB5. Kt on KR6. B on QKt6. Kt on QB8. (Ten pieces.)

Black—K on Q4. P on QB5. (Two pieces.)

Mate in three moves.

No. 8 Position.

White—P's on QB2, KB3. K on KKt4. R on QR1. B on K5. P on KB6. Kt's on Q7, QR7. (Eight pieces.)

Black—B on KB sq. P on K3. K on Q4. P's on QB4, QKt5. (Five pieces.) Mate in three moves.

No. 9 Position.

White—B on KKt sq. R on Q sq. K on QR sq. P on KB2. P on QKt2. Kt on QB3. R on KKt4. P on QKt5. Kt on QB6. P on KB7. Q on KR7. (Eleven pieces.)

Black—P's on KKt4, QB4. K on QB5. Kt on Q5. P's on QKt6, QR7, KKt7, Q7. (Eight pieces.)

Mate in three moves.

No. 10 Position.

White—K on KKt sq. P on KB2. Kt on QB2. P on KKt3. R on K3. P on Q4. Kt on KKt5. R on QB5. P on KB6. B on K6. P on KB7. (Eleven pieces.)

Black Q on KB sq. B on QB2. Kt on KR3. K on Q3. R on QKt3. P on QKt4, P on K5. P on QB6. Kt on QR7. (Nine pieces.) Mate in three moves.

No. 11 Position.

White—R on Q sq. K on QKt sq. P on KKt3. Kt on K4. P on QR4. B on QKt5. P on QR6. P on KKt7. Q on KB7. B on QB7.

Black—Kt on KKt sq. B on QR sq. Q on KR2. P on KB3. Kt on K3. P on KB4. K on Q4. P on QB4. B on Q5. P on QKt5. (Ten pieces.) Mate in four moves.

No. 12 Position.

White—K on K sq. Kt on KKt2. P on K3. B on QB1. P on KR5. R's on QB5, QB8. (Seven pieces.)

Black—B on KKt2. P's on KKt6, QKt6, QKt7. Kt on QR8. R on QKt8. K on QB8. B on KB8. (Eight pieces.)

White to play and compel Black to mate him in four moves.

SOLUTIONS.

No. 1.—1. B to K5. 1. Any. 2. Mates accordingly.
No. 2.—1. Q to Kt4 „ „ „
No. 3.—1. Kt to R2 „ „ „
No. 4.—1. Q to QKt8 „ „ „

No. 5.

1. R to B5 / R to B6	or 1. —— / Kt × R (ch)	or 1. —— / B to K8
2. Q to B5 (ch) / KKt or B × Q	2. Q × Kt / any	2. B to Kt3 (dis. ch) / Kt × R (ch)
3. Mates accord.	3. B disc. (ch) mate.	3. Q × Kt mate.

No. 6.

1. Q to B7 / B × Q	or 1. —— / R × Q	or 1. —— / P to R6 &c.
2. Kt to B6 / any	2. Kt (K4) to B3 / any	2. B × Kt (ch) / Kt × B
3. Kt mates	3. Kt mates	3. Q mates

No. 7.

1. R to R8 / K to K4	If 1. —— / K to B3
2. B to Kt2 / any	2. B × P / K moves
3. Mates accordingly.	3. Mates accordingly.

No. 8.

1. K to Kt5 / B to Q3	or 1. —— / B elsewhere	or 1. —— / P to B5
2. Kt to Kt6 (ch) / K × B	2. K or P × B / any	2. R to R5 (ch) / B to B4
3. Kt to B6 / mate	3. R, Kt or P / mates	3. R × B / mate

No. 9.—1. Q to Kt sq / P × Q 2. K × P / K to Q6 3. Kt to Kt5 / mate

No. 10.

1. P to Q5 / K to K4	or 1. —— / K × R	or 1. any other	
2. Kt × P / R × B	2. —— / any other	2. Kt × P (ch) / K to B5	2. Kt × P(ch) / K to K4
3. P to Q6 / mate	3. P to B4 / mate	3. P to Q6 / mate	3. P to B4 / mate

No. 11.

1. B to KB4 / Q × P			or 1. —— / K × Kt
2. Q × K Kt / B to Kt2	If 2. —— / B to B3	If 2. —— / Q to B sq	2. Q × Kt(ch) / B to K4
3. Q to R7 / any	3. B × B(ch) / any	3. Kt × P(ch) / Q × Kt	3. Q to QB6(ch) / B × Q
4. Q or Kt / mates	4. Q × Kt / mate	4. Q × B / mate	4. B × B / mate

No. 12. A most difficult sui-mate. It was published in "La Stratégie" some years ago, and beat nearly all the regular corps of solvers.

1. B to Q5 (disc. ch) !	B to B5	if	1.	B to B6 (ch)
2. R(B5) to B6	B to K4 (best)		2. R × B (ch)	Kt to B7(ch)
3. P to R6	B moves		3. R × Kt (ch)	P × R
4. R or P × B	Kt mates		4. R × P (ch)	K × R mate

N.B.—The only reason for playing 1. B to Q5 is to provide for Black in the first variation playing 3. B to Q 3; when if 4. R × B Black replies 4. K to B7 (ch), and unless the white B stands at Q5 the white R could interpose.

The Chess Problem Text-book, with Illustrations.—Under this title a notable addition to the literature of the Chess problem art is in course of preparation, and will be issued as soon as possible. It will be the joint work of Messrs. H. J. C. Andrews, E. N. Frankenstein, B. G. Laws, and C. Planck, M.A., and, besides including a selection of 400 problems and positions by those well-known composers, will contain an illustrated essay on the art. The latter will be a novel and special feature in the book, no treatise or dissertation by any recognised authority having hitherto been published in this country. The volume will be brought out by the eminent firm of Cassell & Co., Limited, and the publishing price will be 6*s*.

A MALEVOLENT CRITIC.

The *Saturday Review* has not thought it disgraceful to once more justify its title to be called the "Saturday Reviler." This time it is to scoff at an aged painter of the highest repute—Mr. Herbert—upon his retirement to the rank of "Honorary Academician," after a career such as few, if any, painters living can boast. This it pleases "the Reviler" to congratulate artists upon as "good news," without a word or a thought of what the retiring Academician has done in art, except to utter the contemptible untruth that "his resignation means that he has found out that he is beaten," *not* by the natural failing of old age, but because he failed to impress such a writer as this with the special exhibition of the works of his long life, that was made some few years back to mark the completion of his last great picture for the House of Lords, "The Judgment of Daniel." That exhibition, which most people who know anything about painting in its highest style of religious and monumental art, thought a most interesting display of a painter's career, is described by this most genial of critics as "acres of pallid purple canvases, with wizened saints and virgins in attitudinising groups." But, as Goethe says, "The eye sees what it came to see." The "Saturday's" art critic, if he ever saw this exhibition at all, went to see the "acres of purple canvases, with their wizened saints" which were not there. No matter—it suits his purpose to declare that they were, just as it does to cram into a paragraph more ignorance, insolence, and false assertions combined than is often to be met with even in this locality of literature, where the editor seems to be surrounded with all the prigs, and the pumps, and the snobs of the literary profession. But the art prig had his little game in thus flinging dirt at a venerable painter retiring upon his laurels, and, while he did this with his one hand, he points with his cleaner paw to *his* favourite painters that *he* would recommend for election to the Academic Forty, though such is his habit that he cannot even do this without scattering some slander upon artists he writes down as asses. The force of *Saturday Review* assurance could hardly further go, but done in this dirty way, wrapped up in abuse of an eminent man, it becomes abominable and utterly unworthy of the public press.—*Truth.*

Contents of No. 11.

TERMS OF SUBSCRIPTION.

"Knowledge" as a Monthly Magazine cannot be registered as a Newspaper for transmission abroad. The Terms of Subscription per annum are therefore altered as follows to the Countries named:

	s.	d.
To West Indies and South America	9	0
To the East Indies, China, &c.	10	6
To South Africa	12	0
To Australia, New Zealand, &c.	14	0

To any address in the United Kingdom, the Continent, Canada, United States and Egypt, the Subscription is 7s. 6d., as heretofore.